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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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A Steelmaking Symposium

For several years the Iron and Steel Institute suffered from a dearth of practical Papers, and their special award—the Williams prize—for recognising the merit of such contributions to their proceedings was withheld for a period of three years. The retiring President, Mr. Arthur Hutchinson, tackled this question, and, as a result, no fewer than 24 Papers on steelmaking as practised in the various metallurgical centres were presented at a Symposium held in London last Wednesday and Thursday. We have refrained from publishing these, because there is only a handful of foundries using the open-hearth process for the manufacture of steel castings, but we would recommend the executives of those firms to study the results obtained. In general, of course, the open-hearth furnaces used in steel and malleable foundries are of smaller capacity than those used in steelworks, and have their own peculiar technique. Thus we feel that for the sake of completion, an extra Paper should have been included dealing with this aspect.

From the foundry angle the best contribution was from Dr. Andrew M'Cance on "The Application of Physical Chemistry to Steelmaking," yet it happens to be a theoretical discussion!

Much good could be derived from the organisation of a similar symposium by the Institute of British Foundrymen on Steelmaking for Castings. The variety of processes used in the eighty odd steel foundries of Great Britain is amazing. We have knowledge that there can be found in successful operation the following: Acid and basic open-hearth; arc furnaces of half a dozen different types; high-frequency furnaces; the baby Bessemer; the oil-fired Stock converter; the Sesci pulverised-fuel rotary furnace, and various types of crucible plants. All of these are working successfully, and whilst quality of output, the capacity and frequency of tapping are the factors governing their employment, yet some firms must be losing money hourly through their existing plant not being the best and most economical available. It is true to say that no two steel foundries in this country work on exactly parallel lines.

In the case of the Iron and Steel Institute's Symposium it was largely based on districts, as steelmaking practice is apparently roughly standardised in each area, a phenomenon occasionally to be discerned in the foundry industry. Thus descriptions of processes as practised in Scotland, Durham, Cleveland, Sheffield, Scunthorpe, Irlam and South Wales were included. This method has much to commend it, and is certainly worth bearing in mind when organising similar functions. The reinforcement of the practical side by important side issues, too, is also worth while, and in the case under consideration there was a Paper on steelworks refractories by Dr. Swinden and Dr. Chesters. This focussed attention on the relation of costs as between material employed in construction and that used for fettling and ladle daubing. This is yet a further feature deserving consideration in foundry circles.

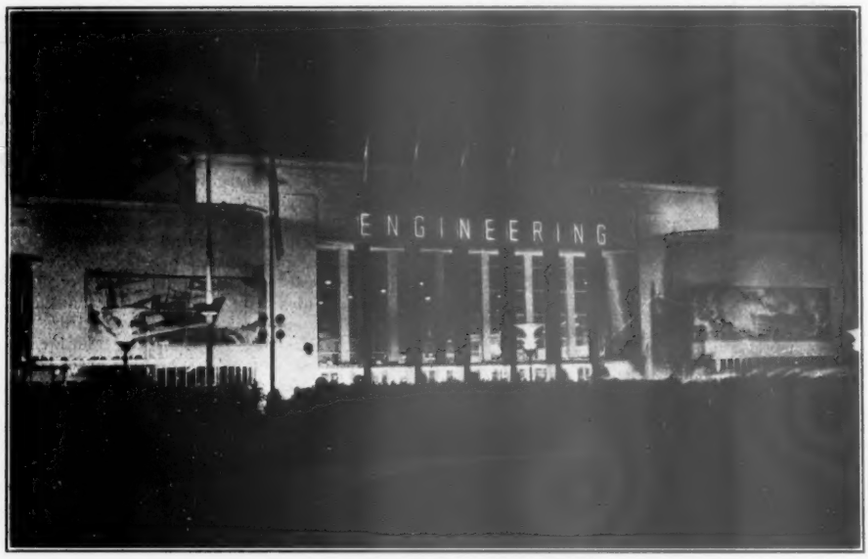
The B.C.I.R.A. Scheme

Lord Dudley, President of the British Cast Iron Research Association, recently made an appeal for funds to enable the Association adequately to equip and house itself for its work. In our annual review issue he gave a detailed account of the progress of the Association, together with the reasons prompting the appeal, which we very warmly endorse. The position is that the Association has found during the past twelve years the great advantage of establishing laboratories in a rented building and of building up an expert permanent staff. Such provision of equipment as has been possible has been made out of income, for the Association has never had and has never previously appealed for the capital resources for either accommodation or equipment. Leaving aside the question as to whether work can be continued indefinitely in the present quarters, we think that separate central accommodation fully equipped would serve as a focus for work essential to the industry if it is to continue to develop in accordance with its present promise, and would be a centre in which the industry could take pride. As a matter of prestige, its value would be considerable, even looked at from an advertising point of view, which is the lowest computation involved. Apart altogether from members, we therefore commend the appeal to those bodies which have responsibility for various sections of the industry, the trade and technical associations.

The amount aimed at is £30,000, of which it is suggested that the industry should contribute half, the remainder being obtained by grant from the Department of Scientific and Industrial Research, which is in full and wholehearted sympathy with the scheme. We understand that it would be most advantageous to the Association if contributions were spread over a short period of years, so as to fit into the framework of the grant scheme, but it is left entirely open to contributors which method they adopt. We congratulate Lord Dudley on his foresight and wish the scheme every success, as must all who have the welfare of the industry at heart.

The Empire Exhibition at Glasgow

This great imperial manifestation, which was opened last week by His Majesty the King, accompanied by the Queen, will remain open to the public until the end of October. The site is in Bellahouston Park, one of Glasgow's largest public parks and occupies some 175 acres. The ground is undulating and well wooded, and it is interesting to note that all the various pavilions and other buildings have been erected without a single tree having had to be felled.



The Engineering Pavilion at the Empire Exhibition. It covers roughly the same area as Buckingham Palace, and is illuminated by 140 G.E.C. Floodlights.

The Park is conveniently reached from central Glasgow by road, tram, bus and underground, and is within a few minutes of the various harbours and Renfrew Airport. There is parking accommodation for about 10,000 cars. The site is dominated by the "Tower of Empire," which is located on a hillside and rises to about 500 ft. above sea level. At the top there is accommodation for about 600 people, and with good visibility one can obtain a view for 60 miles around. The tower is served by electric lifts operating at 500 ft. per min.

Naturally, the Exhibition has a strong tang of Scotland, but the whole Empire is magnificently represented, most of the Colonies and Dominions having their own pavilions.

UNITED KINGDOM PAVILION

Dominating the north-west section of the Exhibition is the United Kingdom Pavilion, which includes four exhibition halls. The exhibits in three of the halls have been organised by the Department of Scientific and Industrial Research under the direction of Sir Frank Smith, and represent the three important national industries of coal, iron and steel and shipbuilding. One hall is devoted to each of these industries. In planning the exhibits the Department has had the fullest possible co-operation from industry. Important organisations, such as the Mining Association of Great Britain, the Gas Federation, the British Iron and Steel Federation and the Shipbuilding Conference, and scores of important firms have freely given their assistance.

Some Engineering Exhibits

The fact that the Exhibition is to remain open about six months has had a profound influence on the nature of the stands, and, generally speaking, the appeal is to the "man in the street" rather than the technician. Wherever the interests of the two can be identified, this has been done. Amongst the firms that have been most successful in this direction is the Mond Nickel Company, Limited, and Fig. 1 is typical of the choice of exhibit they have made. It shows a group of impeller blades made of

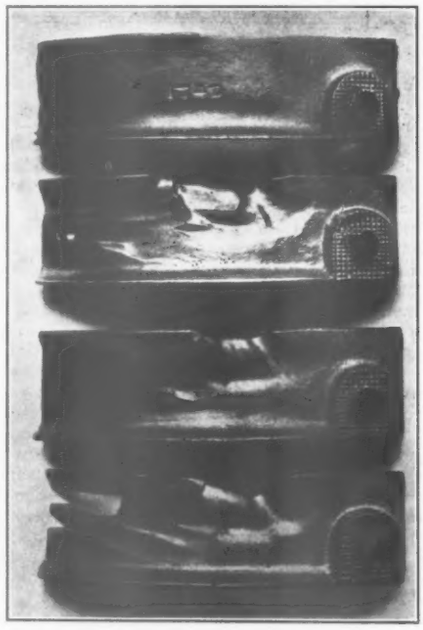


Fig. 1.—An Exhibit by the Mond Nickel Company, showing a Series of Castings in the form of Shot Impeller Blades.

The uppermost is from "Ni-Hard" after 5½ hrs.' use. The next is a "Ni-Hard" blade after 81 hrs. Below this is white iron after 5½ hrs., and the bottom one white iron after 23 hrs.

"Ni-Hard" and ordinary white iron after various periods of service, and illustrates the vastly improved wear-resisting qualities due to alloying.

W. & T. Avery, Limited, also have chosen exhibits, the functioning and application of which are easily understood by the layman, and, *inter alia*, are showing an industrial visible weigher and totaliser, which not only indicates the weight of an individual load, but also totalises the weight of all loads which have passed over the machine.

Obviously, there are plenty of exhibits which, in the main, make an appeal to the technician. Such a stand has been organised by International Combustion, Limited, of Derby. Here foundrymen will see functioning the well-known Hummer screen, whilst an auxiliary exhibit is the Rotap testing sieve shaker for screen analysis tests.

Another exhibit of major interest to foundrymen is that organised by the British Aluminium Company, Limited. Actually, the firm have two stands, and the one in the Palace of Engineering (which we illustrate) is actually engaged on manufacturing souvenirs of the Exhibition in aluminium.

The Riley Stoker Company shows a line of automatic stokers, some of which are suited for foundry application, and a cast iron incinerator for small factory or home use. Most of those in use around London, usually of thin sheet-steel construction, have but a very limited life.

The exhibit of Vickers, Limited, is of an impressive character, and contains a full-sized model of a 230-ton ingot being charged into a furnace. At the other end of the scale is a Vickers projection microscope.

The stand of Stewarts and Lloyds, Limited, takes a form entirely different from those foundrymen are familiar with at past exhibitions. It is designed to show how steel tubes enter into the normal life of the citizen, rather than appealing to the technician.

Catalogues Received

Analytical Apparatus. On this side of the Atlantic, the firm of Harry W. Dietert Company, of 9330, Roselawn Avenue, Detroit, Michigan, U.S.A., is known only for its special apparatus used in connection with sand testing. From a publication just received many other activities are disclosed, all related to the rapid analysis of metals, ores, soils and chemicals. The booklet within its twenty-four pages covers a new form of spectrograph; a densitometer with projection comparator; a micro-pipette; film dryer (for use in spectrographic work); and carbon and sulphur determination trains. The last appears to be of considerable interest, for a claim is made that it will turn out a result in five minutes plus weighing time, no matter whether the material be steel or coke. If memory is not at fault the determination of a sulphur in coke used to require about 24 hours, but that was a quarter of a century ago. Yet we do not remember seeing in the various laboratories we have visited any new apparatus based on combustion, though of course it may have passed our notice.

Electric Motors. A pamphlet (No. 471), which has reached us from Brook Motors, Limited, of Empress Works, Huddersfield, discloses the details of a system this firm has devised for modernising the electric motor plant of any industrial establishment. Briefly, the system is that the firm will, in exchange for any motor not more than twenty years' old, give a generous discount off the price of a modern machine. A grouping system according to age has been devised for allocating discounts. Very simple and straightforward conditions are attached to the transaction.

A party of 60 members of the Yorkshire Coal Exchange, Leeds, paid a visit to the East Hecla Works of Hadfields, Limited, Sheffield, on April 28.

The Iron and Steel Institute

ANNUAL MEETING IN LONDON

The Annual Meeting of the Iron and Steel Institute was held on May 4 to 6 at the Institution of Civil Engineers, Great George Street, Westminster, London, Mr. Alfred Hutchinson, M.A. (retiring President), occupying the chair at the outset.

REPORT OF COUNCIL

The Report states that during the year the membership of the Institute has again increased, and with a total of 2,487 at December 31, 1937, was greater by 244 than at the beginning of the year. During the year 44 members and six associates resigned, and the deaths of 36 members were reported. Nine associates were transferred to membership and seven former members were reinstated. A total of 180 members and 28 associates joined under the scheme of co-operation with the Institute of Metals, fifteen associates were elected under the special arrangements made with the American Institute of Mining and Metallurgical Engineers. The increase in membership must be considered satisfactory, but it is largely due to the election of members of the Institute of Metals, and so large an increase in membership from this source cannot be expected to recur.

The Council regret to record the deaths of the twenty-seven members of the Institute which occurred during the year 1937. Among these are mentioned His Excellency Dr. T. G. Masaryk, the Liberator and former President of Czecho-Slovakia, an Honorary Member of the Institute; Mr. H. C. Bond, a Member of Council since 1929, and an Honorary Vice-President since 1936; Sir John Dewrance, the former chairman of Vickers, Limited; and Colonel A. McBean, whose name was noted for its long association with the iron and steel trade of the Midlands. It is with deep regret that the Council have heard of the sudden deaths of several Spanish members during this and the previous year; they include those of several members who were prominently connected with the hospitality extended to the Institute in 1928.

The statement of accounts for the year ending December 31, 1937, resembles that for the previous year except for differences attributable to the increase in the activities of the Institute and the increase in membership. The ordinary income of the general fund at £12,661 was £1,689 higher than the comparable figure for the previous year. The ordinary expenditure of the fund at £14,525 was £1,669 higher than the comparable figure for the previous year. Expenses on meetings—always a widely fluctuating figure—have more than doubled, being £693 as against £314. Publishing expenses have increased by £614; not only have members received more in return for their subscriptions but the increased membership has necessitated the printing of bigger editions of all publications. According to new arrangements made with the Iron and Steel Industrial Research Council, the grant to that organisation has been fixed at £2,500, a sum which the Council consider to be commensurate with the Institute's interest in research.

Changes on the Council.—The Report states that, as announced at the last Annual Meeting, Dr. Fritz Springorum and Dr. Ernst Poensgen were nominated Honorary Vice-Presidents and Dr. Otto Petersen an Honorary Member of the Institute. During the year Sir Frederick Mills, Bt., D.L., M.P. (Past-President), was also nominated an Honorary Member. The Hon. Roland D. Kitson, D.S.O., was made an Honorary Vice-President and Mr. A. O. Peech was elected a Vice-President. Prof. Léon Guillet accepted the Council's invitation to become an Honorary Vice-President, and Dr. C. A. Edwards, F.R.S., and Mr. J. R. Menzies Wilson were elected Members of Council. Mr. P. M. Ritchie became an Honorary Member of Council on succeeding Dr. A.McCance as President of the West of Scotland Iron and Steel Institute. Since the end of the year Mr. T. B. Smith has succeeded Mr. W. F. Bowden as President of the Cleveland Institution of Engineers, and as an Honorary Member of the Council. In accordance with Bye-law 10, the names of the following Vice-Presidents and Members of Council were announced as being due to retire at the Annual Meeting in 1938:—*Vice-Presidents*: Dr. C. H. Desch, F.R.S.; Mr. Arthur Dorman, Mr. H. Spence Thomas. *Members of Council*: Dr. T. Swinden; Dr. A. McCance; Mr. P. B. Brown; Mr. A. O. Peech; Capt. H. Leighton Davies. Mr. A. O. Peech having been elected a Vice-President, Mr. I. F. L. Elliot becomes due to retire in his stead. No other members having been nominated up to one month previous to the Annual Meeting, the retiring members are presented for re-election.

THE EARL OF DUDLEY, M.C.
(*President of the Iron and Steel Institute*).

Andrew Carnegie Research Scholarships

Grants were made by the Council in 1937 to the following candidates:—

G. E. A. BRAMLEY (The University, Sheffield).—£100 in aid of a research on the oxygen content of steel.

P. T. CARTER (Armstrong College, Newcastle-upon-Tyne).—£100 for an investigation of the properties of graphite. (Second grant.)

H. A. MILEY (The University, Cambridge).—£100 in aid of a research on the thickness of thin oxide films on iron and the law of growth at ordinary temperature. (Second grant.)

G. T. RICHARDSON (The University, Leeds).—£50 in aid of a research on the influence of varying atmospheres on steels. (Third grant.)

G. M. DYSON (Loughborough College).—£50 in aid of a research on the distribution of gases in cast iron, and the influence of founding and pouring methods on the structure, composition and gaseous distribution in cast iron. (Second grant.)

E. HOESCH (Eisenhüttenmännisches Institut der Technischen Hochschule, Berlin).—£100 in aid of an investigation on the breakdown of alitised, that is, aluminium-coated, coatings on cast iron and steel.

J. A. VERÖ (Sopron, Hungary).—£100 for an investigation of the dependence of the structure of cast steel on the rate of cooling.

J. WHITE (Drumchapel, Glasgow).—£100 in aid of a research on equilibria at high temperatures in melts containing ferric oxide. (Second grant.)

Andrew Carnegie Gold Medal for 1937.—For the year 1937 no award of the Andrew Carnegie Medal was made.

Williams Prize for 1937.—The Williams Prize was awarded to Mr. W. Geary for his Paper on "Hot Metal Practice in Five Melting Shops on the North-East Coast," which was published in the No. II volume of the Journal of the Iron and Steel Institute for 1937. The Council are gratified that after an interval of three years this prize has again been awarded, especially as they consider the Paper to be of high merit and an excellent example of the type of Paper which it was the object of the prize to encourage.

The retiring PRESIDENT formally moved the reception of the report and accounts, and the motion was seconded by SIR WILLIAM J. LARKE (Vice-President), who congratulated the Institute on moving to its new offices, a move which was long overdue.

The motion was carried unanimously.

The retiring PRESIDENT referred to the fact that there was present that morning one of the oldest members of the Institute, Mr. George Henry Strick. The members were delighted to see him present, and wished him continued health and happiness, and hoped that he would enjoy his attendance at the meeting that day. Mr. Strick joined the Institute in 1876.

A telegram of greeting had been received from the Verein Deutsche Eisenhüttenleute, signed by Dr. Goerens and Dr. Petersen, wishing success to the meeting. It was suggested that a suitable telegram should be sent in reply.

The proposal was agreed to.

The retiring PRESIDENT also suggested that a telegram should be sent to Sir Robert A. Hadfield, Bt., who was unable to be present. Sir Robert was President of the Institute from 1905 to 1907, and was now the senior Past-President.

The proposal was agreed to.

Induction of the Newly-Elected President

The retiring PRESIDENT said that his final duty was to induct into the chair the President of the Institute for the year 1938, the Rt. Hon. the Earl of Dudley, M.C. It was a great privilege to him to do so. When he (the speaker) first had to consider the making of steel, as distinct from the making of foundry and forge pig-iron, one of the most interesting plants which he visited was Lord Dudley's Round Oak Works at Dudley. It was hardly necessary to speak of the valuable

services which Lord Dudley had rendered to the industry as a whole. He had been President of the British Iron and Steel Federation, and had successfully got it through a difficult period two years ago. Lord Dudley's ancestors had been deeply interested in scientific research and in the technical development of the blast furnace and its consequent benefit to the coal trade. It was in keeping with that family tradition that Lord Dudley should have accepted the invitation of the Council to be President of the Institute.

The Institute was particularly fortunate in that Lord Dudley's year of office coincided with the visit to America. Lord Dudley was well known to the American steel industry, and only a month or two ago visited the United States as one of the British Iron and Steel Federation's delegates who carried to a successful issue most important discussions with regard to the European Steel Cartel price stabilisation. He was confident that American metallurgists and all engaged in the American iron and steel industries would be particularly pleased to greet as President of the Institute such a distinguished member of the House of Lords as Lord Dudley, whom he now asked to take the chair.

Mr. Hutchinson then vacated the chair, which was taken, amid applause, by the incoming President, the Rt. Hon. the Earl of Dudley, M.C.

The PRESIDENT (Lord Dudley) said that it was hardly necessary to remark that this was one of the proudest moments of his life, to have been invited by the Institute to accept one of the greatest honours which it could bestow on those engaged in the great iron and steel industry. It would be a source of the utmost pride to him to occupy the Presidential chair of the Institute. Mr. Hutchinson had said many kind but undeserved things about him, and the members had received them in a most charming way. Mr. Hutchinson referred to the association, which went back for many centuries, of his (Lord Dudley's) family with the iron and steel industry, and he was very sensible of the great pride which they would feel in the honour which had been paid him that day. He could only give the assurance that during his year of office he would do everything that a human being could do, with the limitations of humanity, to further the interests of the great and historic Iron and Steel Institute. When he looked at the list of the famous Presidents of the past, he was very much overawed, and his sense of the honour conferred upon him was still more greatly intensified. He felt a particular responsibility by virtue of the fact that he followed one who had proved himself to be such an energetic, such a popular, and such an able President as Mr. Hutchinson, who had just retired from the chair.

Vote of Thanks to the Retiring President

SIR WILLIAM PETER RYLANDS (Past-President), proposing a vote of thanks to Mr. Hutchinson, said he (the speaker) had been a member of the Institute for nearly forty years, and the recollection of the early period of his association with it which stood out most strongly was the continued presence at every meeting of Mr. Hutchinson and his father. He could not believe that there were other men who had taken a more practical and earnest interest in the work of the Institute than the retiring President and his father. Mr. Hutchinson himself had always taken the keenest interest in every practical Paper presented to the Institute, and his period of office had reflected in a very high degree that practical interest in the welfare and the furtherance of the interests of the technical side of iron and steel. Mr. Hutchinson had always been particularly interested in practical matters which affected the day-to-day work of the practical steelmaker, and in his term of office which had just concluded he had left his mark in just such a practical way upon the well-being and future prospects of the Iron and Steel Institute. While not maintaining that Mr. Hutchinson was entirely responsible for everything that had been done during the past twelve months, personally, he believed that hereafter the members would look back upon the events of the last twelve months as marking a particularly important stage in the history of the Institute. He had been responsible for the Symposium on Steelmaking which was being held. In conclusion, he would like to say that it was one thing to be elected President of the Institute, but it was quite another to carry out the duties in a particularly efficient manner. Mr. Hutchinson had spared himself in no way in attending to the duties of his office, and the members would therefore wish to carry a most hearty vote of thanks to him for the admirable way in which he had discharged the duties of President and for the incalculable services which he had rendered to the Institute during his year of office.

DR. CECIL H. DESCH.

(Bessemer Gold Medallist.)

CECIL HENRY DESCH was born in 1874, being educated at Birkbeck School, Kingsland; Finsbury Technical College; Würzburg University, and University College, London. He was in the Metallurgical Department of King's College, London, from 1902 to 1907; Lecturer in Metallurgical Chemistry, University of Glasgow, from 1909 to 1918 and Professor of Metallurgy, University of Sheffield, from 1920 to 1931. He was president of the Faraday Society, 1926-1928, and George Fisher Baker Lecturer, Cornell University, during the winter of 1931 and 1932. He is a Vice-President of the Iron and Steel Institute, and President of the Institute of Metals; a D.Sc. (London); Ph.D. (Würzburg); F.R.S.; F.I.C., and F.Inst.P. He has written a number of metallurgical works and has contributed numerous Papers to various technical societies. Dr. Desch has been Superintendent of the Metallurgy Department, National Physical Laboratory, Teddington, since 1932.

MR. F. W. HARBORD (Past-President) seconded the vote of thanks, which was carried by acclamation, the members standing in their places and applauding.

MR. ALFRED HUTCHINSON said he was almost overwhelmed with the sincerity of the thanks expressed to him. He was glad to be able to say, at the end of that term of office, that he had had a very happy year. He had enjoyed immensely all the work which he had been able to do for the Institute, and he hoped, and indeed knew, that a very useful year's work had been done under his Presidency by the Council and by all those who had the interests of the Institute at heart and who served it so faithfully. He could not sit down without expressing his personal thanks to his co-members of the Council for all the help which they had given and the forbearance which they had shown him during his year of office, and he would like in particular to thank the Secretary, Mr. K. Headlam-Morley, for all the good work that he had done. In Mr. Headlam-Morley the Institute had an invaluable and able Secretary, who lived for its success, and he would like to thank him personally for all his kindness and attention during the past year. He would also like to thank every member of the staff at 28, Victoria Street. They were a hard-working and able staff who did the Institute great credit, and by their day-to-day work they contributed very materially to its success. He would like to conclude by thanking the meeting very heartily for the way in which the vote of thanks had been received. He had retired from the Presidency, but he had no intention whatever of retiring from the Institute, and as long as he lived he would do his best to further its interests.

Presentation of Bessemer Gold Medal

The PRESIDENT said that a very pleasant duty was to present the Bessemer Gold Medal for 1938 to Dr. C. H. Desch, F.R.S. Dr. Desch was so well known to all the members that it was not necessary to enlarge on his career and achievements.

Addressing Dr. Desch the PRESIDENT said: "It gives me particular pleasure to have the honour of presenting you with this Medal, because you and I have been colleagues on the Council of this Institute for some time, and during that time I have had opportunities of getting to know you and of admiring your great personal qualities, and of realising that a scientist of great international repute is also a very charming and delightful man. I should like you to know what great and unfeigned pleasure it gives to the members of the Council and to all the members of this Institute to be able to present you with this, the greatest honour which it lies in their power to confer upon one of their members. We present it to you not only as a mark of our great personal affection and esteem for you, but also in recognition of your great services to metallurgy and to our industry.

"We feel that it is peculiarly fortunate that you are, in the year in which you receive this Medal, the President of the Institute of Metals, owing to the fact that we are now in such close and family collaboration with your Institute. This Medal also carries with it our gratitude for and recognition of all that you have done personally in soldering that very happy relationship. I present you with this Medal on behalf of the steel industry with my congratulations and good wishes."

DR. C. H. DESCH, replying, said he was profoundly conscious of the great honour done him by the award to him of the Bessemer Gold Medal, the highest award that the Institute was able to make. It had been for him a very happy chance that he entered the career of metallurgy, in which he had found so much happiness over a number of years. He used the word "chance" advisedly, because he never contemplated becoming a metallurgist, having been trained as an organic chemist and obtaining his practical experience first in the chemistry of brewing, and then in the production of fine chemicals. It was only after his return from Germany, where he had been conducting organic research, that he found himself in the necessity of looking for a new post. Prof. Huntington at that time needed a research assistant in metallography. Personally, he knew nothing of the subject, but Prof. Huntington had a very good microscope, and his own experience of the microscope had been gained entirely in bacteriology. The number of metallographers at that time, however, was small, and the handicap was not as great as it would be to-day. The only text-book available was a collection of essays published under the name of "L'Etude des Alliages," by Le Chatelier. When any difficulties were encountered, the simplest plan was to write to Dr. Stead, whose vast stores of knowledge were always at the disposal of every young man who cared to send to him for information,

and he had been fortunate enough in that way to get into the work of metallurgy, and had never regretted it since. He was also fortunate in having been trained under a system which did not call for attention to examinations. He attended both a school and a college which stood completely outside the examination system. The amount of chemistry and physics which they did at Finsbury would seem ridiculously small to the modern undergraduate, but what was taught was taught thoroughly, and all who passed through that training regretted that those institutions had to be abandoned because of the demand for increased examinations and letters to put after one's name, because something was lost in the training of technical men thereby.

He had always enjoyed the most pleasant relations with the industry and with the scientific world connected with metallurgy. The members of the metallurgical industries had always been extremely friendly, and he owed very much indeed to the help of his colleagues in Glasgow, in Sheffield, and at the National Physical Laboratory. He must also acknowledge the very great help which he had received throughout from his wife, originally a colleague and collaborator. He felt that what he had been able to do would never have been done without her help. He would like to thank the President for his very kindly greeting, and to thank all the members and friends of the Institute for the kind reception which they had given him that day.

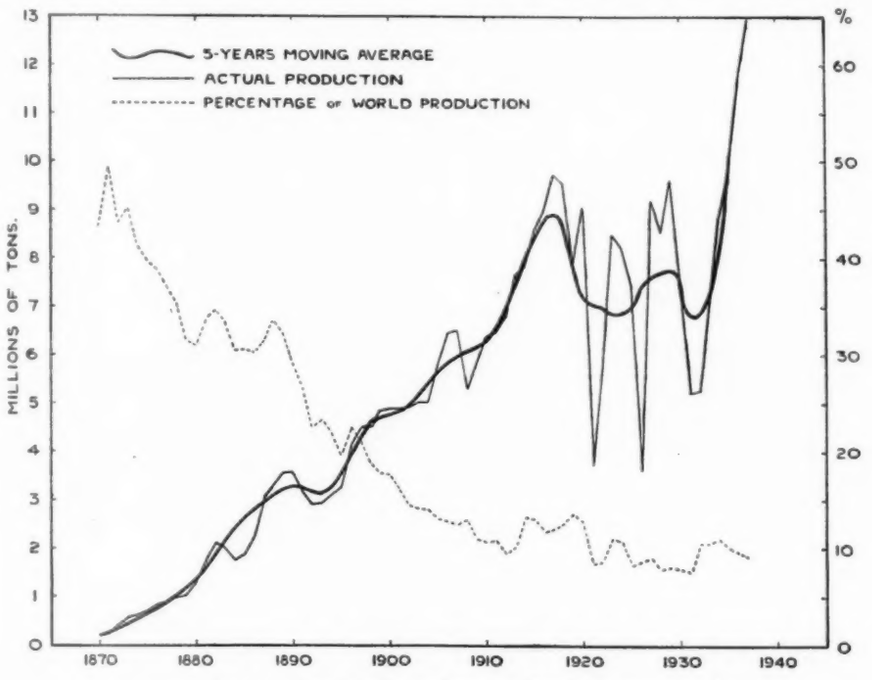


FIG. 1.—PRODUCTION OF STEEL IN GREAT BRITAIN.

Presentation of Williams Prize

The PRESIDENT said that the Williams Prize for 1937 had been awarded to Mr. W. Geary for his Paper on "Hot Metal Practice in Five Melting Shops on the North-East Coast," which was read at the Autumn Meeting at Middlesbrough. He had very much pleasure, on behalf of the members of the Institute, in handing to Mr. Geary the Williams Prize. As had already been said that morning by Mr. Hutchinson, the present was the first occasion for three years that the Prize had been awarded, but Mr. Geary's Paper was exactly the kind of Paper for which the Prize was intended, the kind of practical Paper envisaged by the founder of the Prize. He was glad to see that Mr. Geary's example had been very well followed, because in the Symposium some of the Papers were modelled on that which Mr. Geary had presented. The President then, amid applause, handed the Williams Prize for 1937 to Mr. W. Geary.

PRESIDENTIAL ADDRESS

THE RIGHT HON. THE EARL OF DUDLEY then delivered his Presidential Address as follows:—

"I believe I am right in saying that never before have you been addressed by a President who is actively engaged in the manufacture of iron and steel in the South Staffordshire district, and so, in the first place, I should like to tell you how deeply I appreciate the honour paid to me in being elected your President—an honour which I share with the district that I am proud to represent, and with which my family have had such close associations for many centuries.

"I propose to give a short survey of the iron and steel industry with a special reference to my own district. One sometimes hears the opinion that, as an iron- and steel-making district, South Staffordshire, or, as it is more usually called, the Birmingham district, has had its day; that it is looked upon as having had a glorious past—in fact having been the cradle of the industry not only of Great Britain but of the whole world—and that to-day as an iron- and steel-producing district it is gradually fading into insignificance. I by no means share that view.

"It is true that the history of iron and steel making is wrapped up in the history of South Staffordshire. It would make too long a story to enumerate all of those who are entitled to be included in the list of pioneers of our industry, but the history of iron and steel manufacture in South Staffordshire from the time of my ancestor, Dud Dudley, born in 1618, makes interesting reading, as it traces the progress made by the various processes and plants engaged in the production of pig-iron, wrought iron and steel. To mention a few of the most famous pioneers; Dud Dudley was the author of "Metallum Martis," printed in 1665, and therein may be found an interesting account of the iron trade of those times; it records the great difficulties which had to be surmounted before coal could be successfully used instead of charcoal for the purpose of smelting iron. Another pioneer was Abraham Darby, who first used coke in the blast-furnace instead of coal; he was an ironmaster of Dudley, who afterwards moved to Coalbrookdale. His grandson, Abraham Darby, there built the first iron bridge, which is still in use and spans the river Severn at Ironbridge. It was opened for traffic in 1779. The main arch has a clear span of 100 ft.; the weight of metal, including the cast-iron plates in the bridge, amounts to 308 tons. It is now scheduled as an ancient monument by the Office of Works.

"In 1783, Henry Cort, an ancestor of a recent President, introduced the use of grooved rolls in rolling mills, and in the following year invented the dry puddling process. Later, about 1820, Joseph Hall, of Tipton, a South Staffordshire man, improved on this process by introducing wet puddling, or "pig boiling," so that the wrought iron trade of the district grew rapidly and spread to other districts. An increased production of pig-iron naturally followed and resulted in an increase in the number of furnaces in blast throughout the country, so that by 1825 there were 374 blast-furnaces in Great Britain, of which 262 were in blast, producing 581,000 tons of pig-iron; the average output was about 45 tons per furnace per week.

"About this time the great industrial development of this country began, largely due to the dawn of the steam age which brought with it a rapid development of the steam engine and the building of railways, so that increased iron production followed, and by the year 1861—according to statistics published in Samuel Griffith's 'Iron Trade Circular'—there were 565 blast-furnaces in blast in the whole of Great Britain, and they produced 3,986,320 tons of pig-iron, of which 933,660 tons were produced in the South Staffordshire area. This was an average of 135 tons per furnace per week compared with 45 tons per week in 1825.

"According to the same statistics, the amount of pig-iron produced in England alone was 2,060,760 tons, which entailed a consumption of 12 million tons of coal, 9 million tons of ironstone and 3 million tons of limestone. This enormous consumption of fuel per ton of pig-iron produced would certainly shock the modern fuel expert, but doubtless must have gladdened the hearts of the coalowners of those days.

"In the same statistics it is recorded that in 1861 there were 1,768 puddling furnaces in operation in different works in the South Staffordshire area alone, owned by eighty different firms.

Modern Steel Age

"We now come to the modern steel age, which owes its inception to two fundamental inventions; that of Henry Bessemer, who invented the Bessemer process in 1856, and that of Charles William Siemens, who introduced the open-hearth process in 1861. The development of these two processes in the course of time had a profound effect on the manufacture of wrought iron, which to-day has shrunk to a very small proportion of its former size.

"In the transitional stage from wrought iron to steel, South Staffordshire has played an important part in the evolution and development of the two steelmaking processes. Sir William Siemens was steadily perfecting his process, and he built his first successful open-hearth furnace in Birmingham in 1866, when he succeeded in making good steel from old rails.

"One of the early Bessemer plants to be operated was established at the works of Messrs. Lloyd, Foster & Company, Wednesbury, now the Patent Shaft & Axletree Company, Limited. This firm can also claim to be one of the first to establish a basic open-hearth plant and has continued to develop the open-hearth process since its inception.

"My father, the late Lord Dudley, erected a basic open-hearth furnace in 1889 at Round Oak Works, and I believe I am correct in saying that Mr. Benjamin Talbot, the inventor of the process which bears his name and a Past-President of this Institute, carried out some of his early experimental work in this furnace.

"The work of these pioneers should serve as an inspiration to the younger men engaged in the industry and encourage them to pursue the study of the fundamental principles of metallurgy and chemistry, so that still further development in the iron and steel industry may take place for the lasting good of this country and the world in general.

"As President of the British Cast Iron Research Association, I have recently advocated the expenditure of a considerable sum per annum on comprehensive research work, as I am convinced that without this necessary work our industry would be seriously handicapped.

"When one tries to look ahead into the future of iron- and steel-making, one wonders whether we are moving in the right direction, and whether all that we are trying to do is in the best interests of the industry and the nation.

Co-operation and Collaboration

"This being a free country, we are all born individualists, and as such we are slow to conform to control, rules and regulations. We have always enjoyed freedom of action and freedom in our trading, and it has served us very well. But in the post-war years we have experienced within our industry a measure of co-operation and collaboration, both national and international, such as our ancestors would never have dreamed of. I, for one, firmly believe that this is all for the good. We have voluntarily surrendered some of our individualistic habits without sacrificing our individual genius. By doing so we have developed our industry along the most reasonable and economic lines, and I believe that there is scope for a still further strengthening, and, indeed, expansion of this spirit for our own benefit and for the lasting good of the nation.

"To my mind there are two definite and distinct reasons for close national co-operation. The first and most important is that in time of national emergency our safety depends largely upon our ability to produce the iron and steel necessary to meet national danger. The second reason is that if we are going to maintain our commercial position in the world's markets, we must be equipped with the most up-to-date plant for ensuring the maximum efficiency, and only by such means can the nation continue to enjoy the high standard of living that we have attained compared with all other nations.

"International collaboration is an equally essential factor in the prosperity of our industry. There is a tendency—and I think it is a natural and proper tendency—each to give preference in his own thoughts to the welfare of the industry of his own country, but if we take a wider view our national prosperity is ultimately dependent on that of others. The world is an economic as well as a physical unit. We, in the steel industry, have done our best to co-ordinate our activities on an international basis, and we think that the arrangements we have made compare favourably with those of other industries. They embrace all the leading producing countries in Europe and are not confined to Europe. I think they should ultimately include the industry of the world. The maintenance of these agreements is bound occasionally to cause difficulty; I hope, however, that as and when difficulties arise we shall, all of us, whatever the country to which we owe allegiance, endeavour to reach a solution that may be acceptable to our colleagues as well as to ourselves.

"The international membership is one of the greatest assets of our Institute and its international composition is one of the greatest services which it renders to our industry. Technical progress, which we endeavour to foster, and the spread of scientific knowledge which it is our duty to encourage, know no national boundaries. We are always glad when members from other countries do us the honour of visiting us here in London, and I welcome most heartily those of our friends from the Continent, from America and from other parts of the world, whom I see here to-day. I hope that when we visit Canada and the United States of America in the autumn, many of our members from other countries will travel with us. That may afford a useful opportunity of demonstrating and consolidating the international friendships by which our industry is united.

"I have mentioned that the modern iron industry of South Staffordshire is well over 300 years old; for at least half that period it has been impossible to consider its development and fortunes apart from those of the rest of Great Britain. Similarly, although our national preoccupations must at the moment be great, it is foolish to attempt to assess the prosperity and progress of the British steel industry apart from that of the rest of the world. It will remain a major function of the Iron and Steel Institute to unite in our discussions impartially the views of all nations.

A New Phase

"We are entering upon a new phase in the history of iron and steel making; with all other nations developing their natural resources to the utmost self-sufficiency and with our Dominions and overseas possessions increasing their steelmaking potentialities, it is imperative that we should have the most efficient plant in the world. Germany has greatly added to her steelmaking strength by the acquisition of Austria, in addition to which she is now erecting a large steelmaking plant in the Salzgitter district, which, together with plant to be erected later in Linz and Baden, will, I am informed, have an ingot capacity of about 6 million tons per annum, and will operate largely on native ores, which are of a low grade. This additional output will make Germany easily the second largest producing country in the world, with a capacity of approximately 25 million tons per annum. Russia, also, is rapidly extending, and sooner or later her products will find their way into the world's markets. In 1937, she produced over 17½ million tons of steel. Other countries, too, are entering the steelmaking field, and those already manufacturing steel are increasing their production, with the result that in the year 1937 the world's production of steel was 133,310,000 tons.

TABLE I.—*Production of Steel and of Iron Ore, and Imports of Iron Ore into the Chief Steel-Producing Countries in* 1936.

Country.	Steel production.	Ore production.	Imports of iron ore.
	Thousands of tons of 2,240 lbs.		
United Kingdom ..	11,780	12,701	5,960
Germany	18,900	6,548	18,178
France	6,600	32,689	385
Belgium and Luxemburg	5,080	4,820	10,549
Italy	1,990	812	40
Czecho Slovakia ..	1,540	1,082	546
Poland	1,110	461	340
United States ..	47,770	48,618	2,232
Russia	16,080	27,477	—
Japan	5,000	1,500*	3,768
India	940	2,558	—
Australia	750	1,890	—

* Provisional.

"Even with these developments of steelmaking in all parts of the world, Great Britain, as shown in Fig. 1, has well maintained her proportion of the world output over the past twenty-five years. Up till the Great War, production in this country was increasing each year at a comparatively steady rate, but it must be borne in mind that over this period the use of steel was being substituted for that of wrought iron, and this fact helped to make the growth of steel production more uniformly progressive than in the post-war years.

"The chart shows the exceptional wartime expansion of production, followed by the post-war depression in trade, which owing to our fiscal and monetary policy bore particularly heavily on this country. In spite, however, of the vicissitudes which the steel trade has experienced, the underlying trend of production has been upwards; and I think it can fairly safely be forecast that this trend will continue, so that by 1948-50 Great Britain should be producing some 15 million tons of steel a year. In making this forecast I have regard not only to the growing economic strength and development of the country, but also to the large number of new uses to which steel is being put at the present time.

"This country is, of course, particularly well endowed for steel production with its abundant coal supplies, but in addition to this it is able to supply a larger proportion of its ore requirements than many other important steelmaking countries, as will be seen from Table I.

"We are blessed with wonderful natural resources, and we must develop them at the right time and on the right lines. We have large deposits of low-grade ores still largely unworked, particularly in the Banbury and Oxford districts, which some day will prove to be of great value to the nation. They are adjacent to the South Staffordshire area, which, although it no longer retains the pride of place as an iron- and steel-producing area, is still one of, if not the largest iron- and steel-consuming district in Great Britain. We have no carefully recorded statistics of iron and steel consumption in the various districts, but in the South Staffordshire area in 1936 around 800,000 tons of steel billets and slabs were, I believe, used; in addition, many thousands of tons of steel joists, sections, plates and sheets were consumed, and this heavy consumption continues to grow each year. So I look forward with confidence to the future prosperity of our great industry, which is so essential to the well-being and safety of the nation, and I take courage for the future when I see the support that is given to this Institute and the interest that it commands from all the important iron- and steel-makers in the country."

Vote of Thanks to the President

SIR HAROLD CARPENTER (Past-President), in proposing a vote of thanks to the President for his address, said there was a certain appropriateness in his doing so, because both Lord Dudley and himself had a famous metallurgical ancestor. Lord Dudley's ancestor—and he went back 300 years—represented steel, while his own ancestor, who went back about 160 years, represented iron, so that in their two persons they represented the two metals with which the Institute dealt. The President had given a very brief address, but its quality was not to be judged by its shortness, and he had touched on several important matters on which the members would do well to ponder.

MR. JAMES HENDERSON, who seconded, said that he had neither a distinguished ancestor on the one side nor on the other, but he represented a great body of opinion which would appreciate to the full what Sir Harold Carpenter had said about the President and his address.

ANNUAL DINNER

This function was held at Grosvenor House last Thursday, the President, Lord Dudley, being in the chair. About 900 members and guests were present. Speeches were made by the chairman; Lord Willingdon; Sir Thomas Inskip; Mr. W. R. Lysaght; the Belgian Ambassador (Baron de Cartier de Marchienne), and Mr. Alfred Hutchinson.

SIR THOMAS INSKIP, in replying to the toast of His Majesty's Government, said that in 1932 pig-iron production was only 3½ million tons, as against 10¼ million tons in 1913, whilst the 5½ million tons of steel ingots and castings produced in 1932 turned out to be seven million tons short of our actual requirements in 1937. He hoped that it was not beyond the resources of a modern state to prevent a repetition of that experience.

(*Concluded on page* 387.)

Copper in Cast Steel

By W. B. SALLITT, B.A., A.I.Mech.E.

The addition of copper to cast steel provides a cheap and effective means of improving mechanical properties. Among other improvements accruing from such additions may be mentioned enhanced fluidity of metal and resistance to atmospheric and other types of corrosion. Moreover, the response of copper steels to precipitation-hardening offers a convenient means of developing excellent tensile properties in castings which cannot readily be given a quenching treatment.

Good Casting Properties of Copper Steels

Copper Additions.—Copper additions may be made either prior to tapping, or else to the ladle, the latter method being used where only a proportion of a furnace heat is to be cast in copper steel, the balance being ordinary carbon steel.

Fluidity.—Copper steels are very fluid and easily handled in the foundry. For example, in one motor-vehicle foundry, low-carbon steel containing up to 4 per cent. copper is tapped from electric furnaces into bull ladles and then hand-shanked into moulds of very thin section, such as clutch pedals and generator housings, carried on a continuous mould conveyor. Fig. 1 shows a long box-section steam-shovel cast in 2 per cent. copper steel through a single gate—a job to which copper steels are particularly well suited.

Freedom from Defects.—The thousands of tons of copper-steel castings which have been produced during the past few years indicate clearly that there is no justification for the once prevalent belief that copper steels are red-short. This belief originated from certain troubles experienced in the rolling of copper-steel billets and sheets—operations which, of course, have no counterpart in the foundry. It is now realised that these troubles were due to the condition of the surface scale on copper steel at the rolling temperatures rather than to any inherent weakness of the material at such temperatures.

Welding

Copper steels weld very readily, so that no departure from normal practice need be adopted in salvage welding. They are also well suited to castings which are to form parts of welded assemblies, since they exhibit less tendency to air-harden during cooling from the welding temperature than carbon steels of equivalent strength or alloy steels containing elements such as chromium and manganese. In welding copper-steel castings containing more than about 1 per cent. copper by means of the oxy-acetylene process, it is advisable to use a neutral or reducing flame, since an oxidising flame may give rise to preferential oxidation of iron, leaving on the parent-metal surface a thin film of copper which may become entrapped in the weld. Perfect oxy-acetylene welds have, however, been obtained with copper contents as high as 10 per cent., and it should be emphasised that no special precautions of any kind are necessary in the case of electric arc or resistance welding.

Effect of Heat-Treatment

Though copper steels commonly receive straightforward heat-treatments such as normalising, annealing, or quenching and tempering, their response to such treatments measured in terms of mechanical properties differs somewhat from that of plain carbon or other alloy steels and, furthermore, varies in some measure with their copper content. Moreover, copper steels, unlike other steels, respond to precipitation-hardening. It will therefore be as well before discussing the mechanical properties of copper steels to refer briefly to the effect of thermal-treatment on the distribution of copper present in steel.

Table II.—*Mechanical Properties of Cast Steels containing* 0.31 *per cent. Carbon,* 0.42 *per cent. Silicon and* 0.75 *per cent. Manganese (Lorig).*

Copper. Per cent.	Heat-treatment.	M.S. Tons per sq. in.	Y.P. Tons per sq. in.	Yield ratio.	E. per cent. in 2 in.	R.A. Per cent.	Brinell hardness.	Charpy impact. Ft.-lbs.
—	Normalised 1 hr. at 900 deg. C. ..	38.2	24.3	0.64	29.5	53.4	146	21.1
1.21		43.5	30.4	0.70	25.5	51.0	170	17.2
1.76		51.1	38.2	0.75	19.8	42.0	216	11.1
2.40		54.0	40.8	0.76	16.8	34.7	229	6.9
—	1 hr. at 900 deg. C. Water-quenched.	41.3	29.7	0.72	26.0	61.8	164	32.4
1.21	Tempered 1 hr. at 650 deg. C.	46.6	39.7	0.85	20.5	55.6	198	25.9
1.76		50.5	44.2	0.88	18.8	46.9	216	20.6
2.40		51.8	46.9	0.91	20.0	52.3	222	21.6
—	Fully annealed after 1 hr. at 900	34.4	19.4	0.56	28.7	44.5	134	13.8
1.21	deg. C.	40.1	27.2	0.68	24.8	43.6	161	11.8
1.76		40.3	26.1	0.65	24.5	41.4	159	10.1
2.40		39.9	26.1	0.65	24.5	44.9	157	12.1
—	Normalised 1 hr. at 900 deg. C.	37.3	23.7	0.63	29.3	51.9	146	20.3
1.21	Precipitation-hardened 3 hrs. at	49.3	36.8	0.75	21.0	45.8	201	11.5
1.76	500 deg. C.	52.0	39.9	0.77	18.8	38.8	215	10.1
2.40		53.2	41.7	0.78	19.3	44.2	223	9.3

Fig. 1.—Box-Sectioned Steam-Shovel Boom cast in One Piece in Copper Steel. (Pacific Car & Foundry Company.)

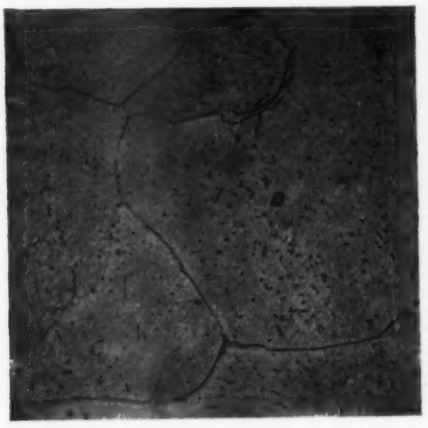


Fig. 2.—Copper Precipitate in a Fully-Annealed Steel containing 1.62 per cent. Copper. Etched Nital. × 1,000.

(By courtesy of Research Department, Woolwich.)

Copper may be present in steel in one of two states:—(*a*) in solid solution, or (*b*) dispersed as free particles of a copper-rich constituent which, for convenience, will hereafter be termed copper.

Copper in solid solution increases mechanical strength and reduces ductility. Free copper, if finely dispersed, as in precipitation-hardened castings, improves mechanical strength to a very marked extent, but it has little or no effect if it be coarse, as in castings which have been fully annealed, or tempered for long periods at relatively high temperatures, *e.g.*, 650 deg. C. In castings which have been normalised or have been tempered for a controlled period—*e.g.*, 1 to 1½ hrs.—after quenching, the particle size and therefore the improvement in mechanical properties falls between these two extremes.

The approximate limits of solid solubility of copper in low-carbon cast steel under varying

Table I.—*Approximate Percentage Solubility of Copper in Cast Steel cooling from* 900 *deg. C.*

Temperature.	Full annealing.	Normalising.	Quenching.
At 900 deg. C.	3½	3½	3½
Just above critical temp.	3	3½	3½
Just below critical temp.	1–1½	1–1½	1–1½
	Balance precipitated Coarse	Balance precipitated Medium fine	Balance precipitated Fine
400 to 0 deg. C.	0.35	1–1½	1–1½
	Balance precipitated Medium fine (Fig. 2)		
Re-heated to 500 deg. C. (precipitation-hardening)*	0.35	0.35	0.35
		Balance precipitated Very fine	Balance precipitated Very fine

* In commercial hardening the reheating period is controlled, so that only about one-fifth of the supersaturated copper is precipitated, since maximum increase in strength is obtained at this point.

conditions of cooling from 900 deg. C. are believed to be as are set out in Table I:—

Mechanical Properties

As shown in Table II the influence of copper on the mechanical properties of cast steel varies considerably with the heat-treatment which they have received. A feature of copper steels is their very high yield ratio as compared with ordinary carbon steels.

TABLE III.—*Properties of Some Commercial Copper Cast Steels.*

Composition. Per cent.					Heat-treatment. Deg. C.	M.S. Tons per sq. in.	Y.P. Tons per sq. in.	E. per cent. in 2 in.	R.A. Per cent.	Brinell hardness
C.	Mn.	Si.	Cu.	Cr.						
0.13	0.62	—	1.0	—	N. 870	31	22	31	54	143
					N. 870 R. 540	36	31	24	50	196
0.11	1.04	1.23	1.74	—	A. 860 R. 490	48	39	25	53	285
0.20	1.16	0.70	1.75	—	A. 900	42	36	23	42	—
0.32	1.26	0.46	1.92	—	N. 900 R. 540	61	47	16	39	285
0.35	0.73	—	1.02	0.63	N. 845	48	32	18	28	207
					N. 845 R. 540 N. 900	55	39	18	30	228
0.28			1.85	1.01	O.Q. 855 T. 675	53	47	18	46	235

and thus steels to be precipitation-hardened will usually contain between 1 and 2 per cent. copper.

Since copper is a ferrite strengthener, it shows to the best advantage in steels of comparatively low-carbon content; and thus low-carbon copper cast steels can often be used to replace high-carbon or more expensive alloy steels which require longer or more drastic heat-treatments. Owing to the fluidity of copper steels, no difficulties in casting will be introduced by this substitution. Copper is also effective when used in conjunction with elements such as chromium and manganese.

The ductility of copper steels is reduced as the tensile strength and yield point are raised, but to a lesser degree than if an equivalent increase in strength were obtained by raising the carbon content. An excellent combination of strength and ductility is obtainable in normalised, or quenched and tempered low-carbon steels containing 2 per cent. copper. The analysis and properties of some commercially produced copper steels are given in Table III.

Precipitation-Hardening

Precipitation-hardening is a simple process well suited to castings for high strength applications which, by reason of their size or shape, cannot readily be quenched. Castings, after cooling in air from the normalising temperature to room temperature (or to about 500 deg. C. in the so-called interrupted cooling method), are transferred to a tempering furnace, and after being held at the appropriate temperature for a controlled period, are withdrawn and air-cooled. Precipitation-hardened castings are not subject to mass effect, that is to say, their hardness and properties are uniform in both thin and thick sections.

The necessary time at heat to give maximum improvement in tensile properties depends on the reheating temperature used, as follows:—400 deg. C., 50 hrs.; 450 deg. C., 9 hrs.; 500 deg. C., 4 hrs.; and 550 deg. C., 2 hrs.

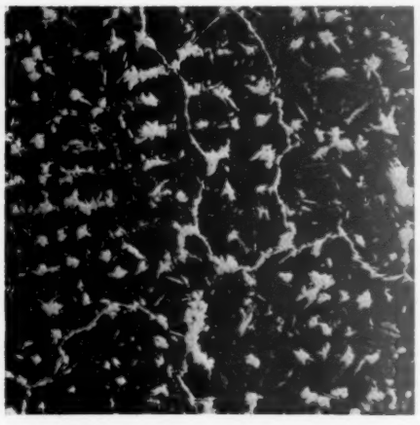


FIG. 3.—MICROSTRUCTURE OF CAST CRANKSHAFT STEEL, AS CAST. × 100.

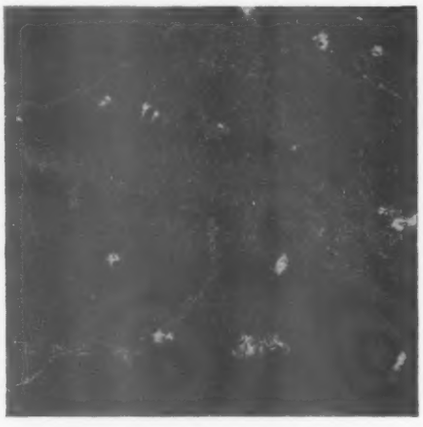


FIG. 4.—AS FIG. 3, AFTER HEAT-TREATMENT. × 100.

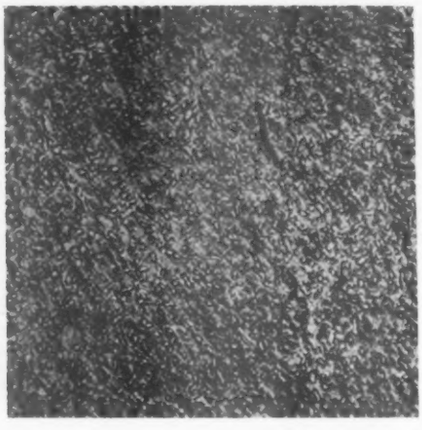


FIG. 5.—AS FIG. 4, AT HIGHER MAGNIFICATION. × 1,000.

(Etched 5 per cent. Nital. By courtesy of Ford Motor Company.)

With normalised steels, tensile strength and yield point are found to increase progressively with the copper content up to about 3½ per cent. With quenched and tempered steels greater percentages may be usefully added if high quenching temperatures be employed. In fully-annealed steels, however, there is no further increase in tensile properties above about 1.2 per cent. copper.

A modified form of annealing, *e.g.*, cooling in about 4 hrs. from 900 deg. C., is frequently applied to copper-steel castings. This treatment produces some measure of precipitation-hardening, developing tensile qualities superior to those obtainable either by normalising or full annealing. Tempering at temperatures of the order of 650 deg. C. after normalising or quenching will, if protracted, tend to reduce the strengthening effect of copper additions, but, as will be seen from Table II, excellent properties are developed by means of quenching and tempering, if the tempering time is limited to about 1 hr. Thus, in high-carbon or alloy steels of the air-hardening type, the presence of copper is of value, since by means of controlled tempering, the diminution in strength resulting from the breakdown of martensite to sorbite or pearlite may be offset to some extent by an increase in strength arising from the precipitation of copper.

The increase in strength arising from the precipitation-hardening of normalised steels reaches a maximum at about 1.5 per cent. of copper,

TABLE IV.—*Copper-Silicon Cast Steels.*

Average composition. Per cent.							Heat-treatment.	M.S. Tons per sq. in.	Y.P. Tons per sq. in.	E. per cent. in 2 in.	Brinell hardness.	Use.
	C.	Si.	Mn.	Cu.	Cr.	Mo.						
1	1.5	1.0	0.8	2.0	—	0.2	A	38	31	7	210	Brakedrums
2	1.5	1.0	0.7	2.0	0.5	—	B	48	41	2	290	Crankshafts
3	1.5	1.1	0.8	3.0	—	—	B	41	31	5	220	Pistons

S 0.06 per cent. max. P 0.10 per cent. max.

A.—900 deg. C. for 30 min.; rapid cool to 790 deg. C. Cool in 2½ hrs. to 725 deg. C. Air-cool.

B.—900 deg. C. for 20 min.; air-cool to 650 deg. C. Reheat to 750 deg. C., hold 1 hr., cool in 1 hr. to 540 deg. C. Air-cool.

TABLE V.—*Alloy Steels containing Copper.*

Average composition. Per cent.							Application.	Function of copper addition.
C.	Si.	Mn.	Cr.	Ni.	Cu.	W.		
1.30	0.45	0.40	3.0	—	1.75	16	Automobile valve-seat inserts	*a, c.*
0.20	0.50	0.60	5.0	—	1.0	—	Corrosion and heat resisting steel, chiefly used in petroleum industry.	*b.*
0.12	0.40	0.30	18	—	10	—	"Digby Steel" for corrosion and heat resisting applications.	*a, b, d.*
0.15	0.50	0.60	18	8.0	2.0	—	Corrosion and heat resisting steel.	*b.*
0.12	0.20	0.50	14	—	1.0	—	Do. do. do.	*a.*
0.30	0.30	0.50	20	—	1.0	—	Do. do. do.	*a, b, c, d.*
0.10	0.20	5.0	18	8.0	3.0	—	Do. do. do.	*a, b.*
0.07	0.40	9.0	18	—	1.0	—	Do. do. do.	*a.*

Steels which are precipitation-hardened at low temperatures are somewhat sensitive to the impact test, but with a re-heating temperature of 550 deg. C. the loss of impact strength is slight; and for this and also for economical reasons, this temperature is usually preferred.

1½ per cent. Carbon Copper-Silicon Steels

Cast steels containing 1.5 per cent. carbon, 2 to 3 per cent. copper, about 1 per cent. silicon and 0.5 per cent. chromium, were originally developed by the Ford Motor Company for

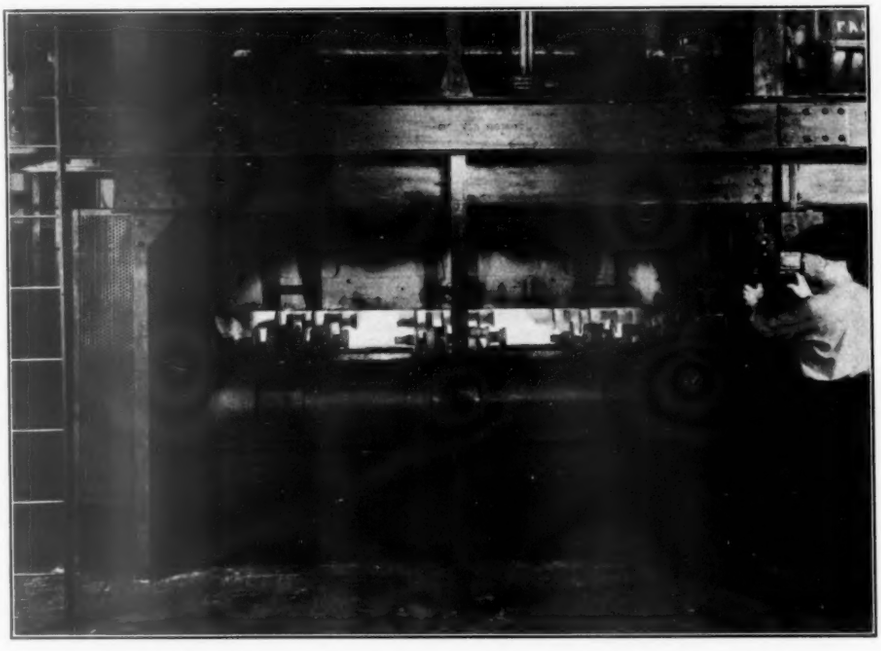


FIG. 6.—HEAT-TREATING COPPER-SILICON CAST STEEL CRANKSHAFTS. (FORD MOTOR COMPANY.)

crankshafts, and in a modified form are now also used for brake-drums, pistons, and a number of minor motor-vehicle parts. The advantages claimed for a steel of this carbon content are, briefly, that it is easier to cast than ordinary cast steel; easier to anneal than malleable iron, and possesses mechanical properties superior to either malleable or grey iron. These steels in the as-

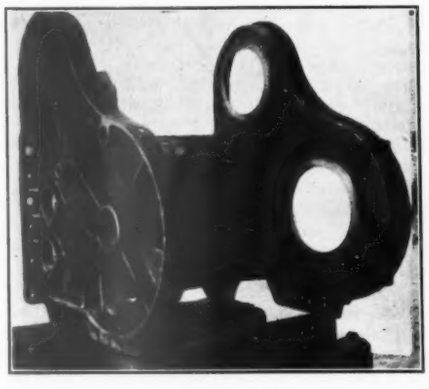


FIG. 7.—HOUSING FOR DOUBLE DRUM GEARED HOIST CAST IN 2 PER CENT. COPPER STEEL. (PACIFIC CAR & FOUNDRY COMPANY.)

cast condition show a structure consisting of a carbide network surrounding a pearlite matrix and are given a two-stage heat-treatment which serves both to graphitise and spheroidise the carbides. The function of the copper addition is to improve mechanical properties, fluidity, and also accelerate heat-treatment. Chromium is added to the crankshaft steel to improve wear resistance, but is omitted from the piston and brake-drum steels, which therefore contain a relatively greater proportion of temper carbon.

The analysis and properties of some cast steels of this type are given in Table IV, whilst Figs. 3, 4 and 5 show the structure of the crankshaft material before and after heat-treatment.

Copper in Complex Cast Steels

Copper is added to a number of complex alloy steels to improve one or more of the following properties:—(*a*) Mechanical strength; (*b*) corrosion resistance; (*c*) fluidity, and (*d*) resistance to grain growth at high temperatures. A study of these complex steels is outside the scope of this article, but a few typical examples are given in Table V. The letters in the last column indicate which of the above improvements is achieved by means of the copper addition.

The Iron and Steel Institute

(*Concluded from page* 384.)

It was satisfactory to learn that the steel trade was now on a parity with foreign countries, having spent something of the order of £30,000,000 during the last few years on its re-equipment. He saw no reason why a further period of prosperity should not be ahead of the industry.

There was a wide representation of the foundry industry present. Mr. C. W. Bigg (President of the Institute of British Foundrymen) was unfortunately kept away through illness. However, two Past-Presidents were present—Mr. V. C. Faulkner and Mr. J. E. Hurst. Several Past-Branch-Presidents were amongst the guests, including Mr. C. H. Kain, Dr. A. B. Everest, Mr. G. T. Lunt, Dr. C. H. Desch, and Dr. T. Swinden. Others prominently associated with the foundry industry were Mr. Barrington Hooper, Mr. E. J. Fox, Mr. H. W. Lockwood, Mr. J. Deschamps, Mr. G. E. Wells, Mr. Frank Russell, and Mr. A. C. Turner, Mr. P. B. Brown, Mr. T. H. Turner, Mr. John Lake, Mr. B. B. Kent, Mr. John Fallon, Mr. Van Maarle, Mr. W. E. Dobson, Mr. G. C. Clayton, and Mr. T. Makemson (Secretary of the Institute).

Continental Notes

French Pig-Iron Production Declines

French production figures for pig-iron for March have brought little surprise to the industry. The total is given as 552,000 tons against 559,000 tons in February. This is the sixth consecutive month in which production has fallen, the figure for last October having been 705,000 tons. During the first three months of this year 13 blast furnaces were shut down, and there is every likelihood that this movement will continue. This reduction in production of 21 per cent. in six months is rendered more serious by the fact that consumption has dropped still more rapidly, being estimated at only half of what it was in October. The result is that blast furnaces are stocking iron and unless consumption develops shortly, will be obliged to consider very sharp reductions in production. The outlook for May is frankly bad, the only branch of foundry business which continues to show any activity being that working for the national defence. In spite of the low level of activity there is a shortage of skilled moulders due to the 40-hr. week and to the drop in the individual efficiency of the men. As to prices, these are still at the level of January, 1938, although a demand for increases has been made to the Price Fixing Committee.

Increasing German Production

Reports which have been made public in Germany indicate that by the end of this year four new blast furnaces will have been completed and eight old ones demolished. During 1939 the construction of seven new furnaces is envisaged. At present there are 170 blast furnaces in Germany (including three in Austria) of which 132 (including two in Austria) are in operation. At the end of last year there were 175 blast furnaces, of which 120 were in operation (including the Austrian ones in each case). Production of pig-iron in March amounted to 1,521,471 tons against 1,348,645 tons in February. The daily average production was 49,080 tons against 48,166 tons in February. The improvement is even more noticeable over the first quarter of this year, during which the average daily production was 47,865 tons against a production of 42,076 tons per day last year.

New Titanium Pig-Iron

The Lubeck A.G. blast-furnaces have patented a method for the production of a new pig-iron containing small quantities of titanium. The usual iron ore is mixed with ilmenite and the smelting carried out so that a titanium content of from 0.8 to 1.2 per cent. is obtained. About 60 per cent. of the titanium in the ilmenite is reduced and passes into the iron. The slag obtained in a furnace operating with this method is a practically pure mixture of calcium oxide (CaO) and aluminium oxide (Al_2O_3) instead of being the usual calcium silicate mixture. The quantity of fuel required is about the same as for the production of a high-silicon pig-iron.

Improvements Indicated in Belgium

Although Belgian producers are somewhat pessimistic, the situation seems to be taking a very slight turn for the better. During the first quarter of this year, to be sure, ten blast furnaces were shut down, with a consequent reduction of 15 per cent. in production, but during the last fortnight two of them have been relighted at Marcinelle by the Thy le Chateau works. The main cause of difficulty lies in home consumption, which is fairly stable at about half of what it was during the peak period of last year. The first quarter of 1938 shows an improvement over the quarterly production last year, but sales have been dropping from month to month, the average last year being 145,800 tons per quarter, and sales for the first quarter of this year being 148,400 tons. At the moment there is a slightly improved demand for export.

Foundry Mechanisation

Mr. G. E. FRANCE'S ADDRESS TO LONDON FOUNDRYMEN

At a meeting of the London Branch of the Institute of British Foundrymen, held at the Charing Cross Hotel, London, with the Branch-President (Dr. A. B. Everest) in the chair, MR. G. E. FRANCE addressed the members on the subject of foundry mechanisation.

MR. FRANCE said that at short notice he had been asked to discuss some aspects of foundry mechanisation which normally were not very much discussed. When Mr. Faulkner and Dr. Everest had reviewed the matter with him, they had expressed the view that all present at the meeting could be presumed to know what mechanisation was. Being an individual who never took anything for granted, however, he would prefer to express first his own definition of it. He defined mechanisation as being merely the conversion of manual operations into mechanical operations—a definition covering a multitude of sins, and operations, and giving him considerable scope.

If that definition were right, it was certainly true that mechanisation was not new. We lived in an age in which, unfortunately, catchwords became, as it were, the pegs upon which we all, at some time or other, hung our opinions and became keenly controversial. If we could believe that mechanisation was by no means new, that it was initiated by the man who gave up the idea of pulling a sled loaded with timber in the forests, and who fitted a wheel to the front of the sled and made it into a wheelbarrow, we realised that it was not a device in itself, that it was not a catchword and was not merely a palliative.

A Modern Development

Mechanisation, as we knew it to-day, was introduced coincidently with the beginning of the industrial era. Probably Arkwright, by the introduction of his "spinning Jenny," was one of the first to replace manual labour by mechanical operations, and by mechanisation a great deal could be achieved in increasing production and cheapening the products made. Since the beginning of the industrial era in this country there had been continual development of mechanisation. Until recent years, however, attention was concentrated on merely the production of a machine, by means of which a certain process could be applied. We are all aware of machines produced for the performance, by mechanical means, of operations which previously were carried out solely by hand. Some ten or twenty years ago, however, another phase had been introduced, principally in America at first, whereby mechanisation was extended beyond single unit machines to whole series of processes or operations. It was felt that, not only could a particular operation be mechanised, to replace manual labour, but that a whole series of operations, which previously were separate entities, could be mechanised together. Thus there was the introduction of the conveyor system linking together several mechanised units to form a mechanised whole.

It was comparatively recently that such ideas were applied to the founding industry; but they had been applied, and there was no question that they would continue to be applied.

An Accepted Achievement

If it was accepted that mechanisation was a natural evolutionary development, then to be so egotistical as to suggest that it was an absurdity and could be controverted was akin to running one's head into a brick wall. No one would dream of suggesting that Boyle's law was wrong, although it had seemed, some time ago, that one member of the Institute was attempting to do that. No one could controvert a natural law of evolution, and, inasmuch as mechanisation conformed to the natural laws of evolution, any attempt to restrict its influence was akin to emulating the example of King Canute in trying to brush back the waves. We must regard it as irresistible, and the wise and logical course, therefore, was to see how far we could flow with that natural tendency in our industry. Other industries had adopted it years before the foundry industry, with beneficial results to the extent and the cost of their productions. Let the foundry industry see what it could do in following their example.

With the possible exception of the introduction of the early types of moulding machines, the application of mechanisation to the foundry industry had been very largely the result of pioneer work in America—in the second phase of the development of mechanisation, *i.e.*, its extension to a whole series of operations. As a result, mechanisation had advanced to such an extraordinary extent, and so quickly, in the foundry industry, as compared with other industries, that it had left many founders bewildered and somewhat be-fogged. It was axiomatic to-day that material and scientific development far outstripped social and mental development; it was difficult to attune minds to the new conditions, and he was stating his opinions and throwing out ideas to stimulate thought on the question, so that the meeting could consider what was to be gained, not by trying to resist a natural development, but by adopting it in, and adapting it to, the foundry.

Economic Justification

It followed, from his definition of mechanisation as the conversion of manual operations to mechanical operations, that each individual replacement, or each single development, along the lines of that definition, was justifiable only economically in the first place. So that we turned to mechanisation firstly as a means of increasing production and of lessening the cost of that production. There were, of course, other incidental advantages; but the crux of the situation was the economic value of mechanisation. A question, for example, often asked, was: "What is the influence of the percentage of wasters in a mechanised foundry upon the success of the mechanisation?" The answer was that it did not matter a jot. The criterion was not the amount of wasters made, but the unit cost of the product. Taking a hypothetical case, he said that if a foundry were producing 5 per cent. of wasters before mechanisation, and the unit cost of each casting, or the cost per ton of castings, made there was X, and if, after mechanisation, the wastage leapt to 12 per cent., that did not matter in itself, provided that the unit cost of each casting, or the cost per ton of castings produced, was less than X. All other considerations were related to the cost of production, of course; but for the moment he was ignoring those other considerations.

Mechanisation must not be applied willy-nilly; it was absurd, for instance, to spend £10,000 on mechanisation if it were impossible to recover that capital cost within reasonable time by reduction of the unit cost of production resulting directly from that mechanisation. It should not be regarded as a panacea for all ills, but must be submitted to the acid test as to whether it improved the economics of production.

Unit Cost of Production

The cost of the individual unit of production as it left the foundry, of course, could be determined fairly readily, particularly by those who studied the excellent results of the Costing Sub-Committee of the Institute—as he hoped every member of the Institute had done. From the point of view of the individual foundry it was the cost as delivered to the customer; from the point of view of the foundry which was a department of a large works, it was the cost as delivered to the department receiving it. In assessing the unit cost of production, when contemplating mechanisation, the capital cost involved in the mechanisation itself must not be forgotten; proper provision must be made for the depreciation of the plant—and in these days of rapid material and scientific development that assessed rate of depreciation should be high. It should be reckoned, not in terms of the cost of the iron and steel in it, but in terms of the ideas that the plant represented. Sometimes one saw machines which had been in use for 30, 40, 50, 60 or more years, and they were still working; but they were very inefficient as compared with modern standards.

The economic survey entailed in the consideration of mechanisation should include the writing-off of the whole of the capital cost of the mechanised system in such a time that the funding of it should enable the foundry owners to replace it by a more modern plant as and when the latter was developed. He knew of one case in which a foundryman, whilst appreciating that mechanisation in itself was beneficial, had felt that in view of the rapidity with which one good idea succeeded another, there was no guarantee that any mechanisation adopted at any particular time would represent the zenith of mechanisation a year later, and, therefore, that it was dangerous to adopt mechanisation. One should not be misled by that consideration, however, because it was present at all times. When considering mechanisation one must take as a criterion the state of practice at the moment; but protection must be afforded by amortising the cost in such a way that portions could be replaced readily as they were superseded by something better.

Market Research

Consideration must also be given to the certainty of demand for the product being made, to the type of product, details of pattern changes, types of machines necessary, etc. One must not overlook any point which was likely to have a bearing on the problem. From his own experience he could say quite seriously that much harm had been done by mechanisation enthusiasts who, rather like the bull in the china shop, had rushed willy-nilly into it without considering every factor in the situation. It paid, when spending money, whether it was one's own or somebody else's, whether one was buying a pair of shoes or a motor-car, to consider every point that could possibly have a bearing upon it. If one resorted to mechanisation which was faulty, one's ideas were likely to become so distorted as to the possibilities of sound mechanisation that serious losses would be incurred in the future by abstention, apart from the loss in respect of the plant installed in the first place.

Quality Amelioration

There were some other factors to be borne in mind which were difficult to assess economically, but which, nevertheless, had an economic bearing. They included factors such as the quality of the product, the certainty of making promised deliveries, improved conditions in the shops, higher wage incentives, and so on, which warranted attention in the consideration of a scheme as a whole.

Having considered the situation from all those points of view, one had facts available upon which to decide, not only whether mechanisation could be adopted, but, what was equally important, how far it could be applied. Bearing in mind his definition of mechanisation as the conversion of a manual to a mechanical operation,

it could be assumed that mechanisation could be applied in any industry—and most of his remarks applied equally well to other industries as to the foundry industry—within the range from zero to 100 per cent. In the foundry industry the continuous casting system had come to be regarded as a 100 per cent. application of mechanisation. The factors determining the percentage of mechanisation that could be applied in any one particular case were very considerable, and they must all be considered before making even the preliminary steps towards mechanisation.

A Word of Warning

It might be thought from some of his remarks, he commented, that he was endeavouring to exert a restraining influence instead of creating enthusiasm for mechanisation. He considered, however, that as a member of the Institute of British Foundrymen he was doing a reasonable service in giving his ideas honestly and in urging founders to survey the situation in its entirety, rather than to regard mechanisation as a panacea for all ills, as something which could be poured out of a bottle, so to speak, and left to work itself out.

It was rarely the case, however, that, in the modern foundry, no matter what type of product it was producing, the principles of mechanisation could not be applied successfully in some degree. The successful foundry was the one which assessed the proper percentage of mechanisation to apply, and applied it efficiently and intelligently. The percentage was a variable; changing conditions would change the position of the pointer on the scale, but the proper percentage *could* be arrived at.

New Factory Act

Until a comparatively short time ago, the foundry industry had depended entirely on manipulative skill and manual labour. The first Factory Act, introduced more than a hundred years ago, was decidedly necessary. The social conscience of to-day revolted at the conditions which existed in factories before that first Factory Act was applied; those conditions had demanded the passing of such an Act. The Factory Act which would come into operation in 1938 seemed to many people to be rather "drawing-roomish," and some of the conditions demanded seemed by some people to be completely Utopian. But it would be agreed that the arduous labour conditions which had obtained in foundries in the past had left very much to be desired; and if only from the point of view of ameliorating the conditions under which the men worked, by converting various manual operations to mechanical ones, mechanisation was very desirable.

The common-sense application of mechanical principles to industrial processes would go on. Apart from its effect upon profit and loss accounts, when properly applied and intelligently operated, it did improve working conditions, it provided increased rewards, it resulted in the production of better and cheaper products, and it gave certainty of performance.

Unfortunately, the problem of the application of mechanical principles had in many cases been shrouded in somewhat nebulous ethical ideas, resulting in a traditional hostility to anything new or anything having a long name or an apparently scientific basis. But that state of affairs was gradually changing, with the introduction into the foundries of men who regarded scientific principles as of greater value than traditional prejudices. He fully appreciated the traditions of founding; but those traditions should be restricted to their proportional place.

All were fundamentally interested in finding any means available of eliminating the variables in their jobs and replacing those variables by constants; by such means the difficulties which arose day by day were lessened, and results could be reproduced definitely.

DISCUSSION

The BRANCH-PRESIDENT (Dr. A. B. Everest), commenting upon the danger of over-mechanisation, said that during his recent visit to the United States he had gathered the impression that one of the major troubles there was over-mechanisation, particularly in the rolling mills and motor vehicle plants. It seemed to him that this was one of the biggest factors in the instability of that country to-day, since production when on an economic level exceeded the demand. The instability caused by this state of affairs was one of the factors behind the rapid rise and fall in the business barometer in the United States in modern times.

Another factor which had not been discussed by Mr. France was the relation between labour and mechanisation. He believed it would be fair to say that the mother of mechanisation was lack of skilled labour, and the reason why mechanisation had developed so rapidly in the United States was the dearth of such labour and the fact that often unskilled negroes were the principal form of labour available.

Mr. France had referred to the use of machines which were 50 years old. Presumably he did not condemn out of hand all such machines, because in some cases special types of equipment were satisfactorily being worked under conditions where it would not be economic to scrap them and replace them by more modern equipment.

As an example of mechanisation to-day he referred to the development of the permanent-mould method of making iron castings. He had been particularly interested in this, and after seeing it in operation in the United States had been inquiring into the possibilities of the method in this country. It appeared that this was a typical case in which mechanisation led to such large-scale production that it was difficult to find a state of conditions where the demand would keep pace with the supply.

Over-Mechanisation

MR. FRANCE, replying to the Branch-President's reference to over-mechanisation in the American sheet steel and motor vehicle industries, said that quite recently he had listened to an address by a very well-known American who had been dealing with such problems throughout his life; that speaker was an associate of Taylor, of the Taylor-White process, and he had said that the only solution he could see for that particular state of affairs was the continued application of mechanisation. Mr. France felt bound to admit, however, that he objected very strongly to that suggested solution, because he did not see how it was to apply.

If he were to put forward any principle it was that the application of mechanisation to foundry processes could only be decided by reference to the conditions in each individual case; in other words, it was very unlikely that a particular application of mechanisation in one foundry could be duplicated in any other with the same degree of success. Each case must be the subject of a separate investigation, although, of course, experience of other installations might prove of great use in deciding the degree to which it should be applied.

Limited Markets

MR. HARRY FOX, commenting upon economic production as being the primary consideration in considering mechanisation, asked whether industrialists could really control the extent to which mechanisation was applied. For instance, if a founder installed mechanised mould carriers, moulding machines, and sand-conditioning plants, he had to consider also the installation of mechanical means for ensuring the continuous supply of metal. In many instances he had seen founders make a start with simple roller conveyors for moulds, and hand-squeeze machines; then it was found that further mould conveyors were necessary, and perhaps extra cupolas, and in some cases electric or rotary furnaces, in order to enable the other plant to work to full capacity. When a slump occurred, however, the whole of the mechanised plant became idle, and entailed huge overhead charges.

Although there were big demands for products such as motor-cars, and for some special products such as mowing machines, wringing machines, etc., the average foundryman could not afford to mechanise his foundry, because the demand for any individual casting was not sufficient to warrant the installation of special machines, conveyors or melting equipment. The markets for small castings might be larger in America, but in this country the markets were limited, except for a few products. Therefore, the problem of assessing the proper degree of mechanisation to apply to any foundry was of paramount importance in the British foundry industry.

Partial Mechanisation

MR. FRANCE commented that Mr. Fox had given an admirable illustration of the point he had made in his address concerning certainty of demand as being a factor in the consideration of mechanisation. Possibly, in cases where huge mechanised plants had been developed and had had to remain idle during a slump, entailing excessive overhead charges, the original schemes of mechanisation had been ill-advised and the people responsible had not made a proper economic survey. Whilst it might not be possible, in view of the probable demand, or for any other economic reason, to justify the complete mechanisation of a foundry, it might be possible to justify the partial mechanisation of some section of it. For instance, if it were recognised that in the production of a ton of castings in a small foundry some 200 or 300 tons of material had to be moved, and if it were discovered that 100 tons of that was sand, it might be possible to justify the mechanisation of the sand preparation and distribution units. He had in mind a horizontal scale of values, as distinct from the vertical.

Incidence of Scrap

MR. J. N. BURNS said he had read many books and Papers, and had listened to many lectures, on the subject of mechanisation, but he had never seen or heard the subject put forward so clearly and concisely as by Mr. France. The foundry industry would be well served if the address were published and carefully studied by every foundryman. He had seen cases of over-mechanisation, and he believed that if every foundryman regarded the whole problem as one of evolution from the manual to the mechanical method, the whole situation in regard to mechanised foundries, and the outlook of the foundryman, would be altered considerably. If the remarks of Mr. France were taken to heart, one should not hear of the failure of so many mechanised plants, which were damaging the foundry industry. If mechanisation were applied correctly, there would be a certain amount of it in every foundry, within the suggested range; but he uttered a warning against the installation of 110 per cent., for that resulted in tragedy.

Perhaps Mr. France had been skating on rather thin ice when he had referred to the unit cost per ton of castings and the scrap produced by mechanical plants. The percentage of scrap in a mechanical system must of necessity be lower than in an ordinary manually-operated foundry; every unit produced in a mechanised foundry carried the additional cost of all non-productive labour, overheads of the plant and supervision, so that a mechanised foundry could not afford a high scrap figure. Very careful consideration must be given to scrap yield.

Commenting on the statement that the decision to mechanise a foundry must rest entirely on economics, Mr. Burns said he had been brought up in a school which did not quite agree with that. If one were able to ease the labour of

the men, one had achieved something, even if the cost of a particular component were not decreased. The result might not be apparent in the balance sheet for a year or two, but ultimately a return would be shown. The social value of mechanisation should be considered, apart from monetary considerations.

Whilst he agreed that the plant should be written off at a very high depreciation rate, he suggested that it should be written off in a manner rather different from the usual; one should write it off by the normal Income Tax Method, and then allow an obsolescence figure. It was common in the motor-vehicle industry, because the trade demanded it, and if every small foundry adopted that practice it would be able to adopt new ideas as they came along, instead of being prevented from so doing through the absence of funds upon which to draw for that purpose.

As to the suggestion that the Factory Act to be applied in 1938 might be regarded by some people as being rather "drawing-roomish," he said that that opinion would not be held ten years hence. We were living in an enlightened age. For example, in American plants air conditioning was standard practice; all the new aircraft factories were being carefully ventilated in this country, and the Ford Company had installed plant to handle more than 600,000 cub. ft. of air per minute, simply and solely to give the men better working conditions.

Social Factors

MR. FRANCE, speaking with regard to the scrap percentages he had mentioned when comparing a mechanised foundry with one that was not mechanised, said he had mentioned them merely in order to illustrate his point, and perhaps he had exaggerated for the sake of illustration. The point was that the really basic criterion when considering mechanisation was the unit cost of production, and not the scrap percentage or any other factor; all other considerations affecting the success or otherwise of the scheme would be reflected in the cost of production.

He was sorry if he had given the impression that the economic factor was the *only* consideration. He had tried to make it clear that that was the *primary* consideration, but had stressed that others, such as working conditions, rewards, quality of castings, and so on, were of importance. Recently he had noted with pleasure that a gathering of prominent and influential industrialists had stressed publicly their conclusion that too much attention had been concentrated in the past upon the wage incentive as being the principal consideration in regard to production, and that too little attention had been devoted to the forty odd other factors which affected production and in which were reflected the social conditions in which the people were employed.

As to depreciation, he said he had suggested that the capital cost of the mechanical plant should be funded, so that, when necessity arose, it could be replaced, even wholly if desired, and money would be available to meet the cost.

His reference to considering *optimum* production as distinct from *maximum* production had a bearing on Mr. Burns' remarks concerning the Factory Acts. He held the view that Acts of Parliament represented the opinions of the majority of the people, and served to spur on those who wilfully despised the public conscience. The new Factory Act, with the assent of the people, represented the views of reasonable and decent people.

The Over-Mechanisation Bogey

MR. V. C. FAULKNER (Past-President of the Institute), commenting on the references to over-mechanisation, suggested that it was not really a question of over-mechanisation, but of over-specialisation; the plants which were labelled "over-mechanised" were usually too specialised, and did not give the essential elasticity. Again, he suggested that there was very little justification for much reference to the dire results of over-enthusiasm, because to the best of his knowledge there were about 60 mechanised foundries in Great Britain, using the term "mechanised" in the broadest sense, and in only one case had the plant been pulled out. The accounts of most of the 60 concerns which had mechanised showed a very handsome return on the money expended on the plant.

MR. FRANCE remarked that there was much that could be said, but he wondered whether that particular meeting was the place at which to say all of it. He did not wish to be regarded as a protagonist of either under- or over-enthusiasm; but presumably the cases of ill-judgment and over-enthusiasm to which he had made oblique and slighting reference had escaped Mr. Faulkner's attention, for they did exist.

Market Analysis

MR. V. DELPORT (Past Branch-President) emphasised that mechanisation resulted in immediate increase of production, and it was the responsibility of the management of any foundry to ensure, before taking steps to mechanise, that a market was available for the increased production. He was glad that Mr. France had drawn attention to that important factor. Also he agreed about writing off as quickly as possible the capital expenditure on mechanisation.

The necessity for studying all the factors carefully before deciding to adopt any scheme of mechanisation seemed obvious. But he mentioned a case in which much money had been expended unnecessarily on new equipment as the result of lack of study and of foresight. The case in question was that of a foundry he had visited in America, where the system of cleaning castings had been modified completely, at a cost of about 175,000 dollars; after six months it was found that that system was less satisfactory than the old system, and that previous system, slightly modified, was re-introduced.

Although many people even to-day believed that articles quantity-produced by mechanised plants were not of such good quality as those produced by hand, there was no doubt that quantity-produced motor-cars, for instance, would give completely good results for a period of years. One appreciated, of course, that the artisan who made a product by hand followed that product step by step through the various processes. Quantity-production, on the other hand, was impersonal, and it became necessary that there should be a strict control of the production at all stages, and not merely at the end of the process.

Controlled Production

MR. FRANCE said that one of the greatest advantages of mechanisation was that it gave the management complete control of production at all stages, which it was impossible to achieve with manual operation; it enabled the management to eliminate the variables and to substitute constants. The curse of founding in the past was that it had consisted of a large number of variables, which might result in the production of a good casting, or might not.

Mechanising Small Units

MR. BROWN asked what general steps Mr. France would suggest in applying mechanisation to a small foundry.

MR. FRANCE said that Mr. Brown had rendered good service by asking him to get away from theory and to get down to brass tacks. The points raised were very material. But the fundamental principle, that it was necessary to make a complete economic survey before adopting any scheme of mechanisation, applied generally. It meant considering each operation from the point of view of whether or not it could be done better or more cheaply by means other than those employed at the moment. If one were satisfied that existing methods could not be improved upon, one was very fortunate. If an operation could be improved—and that should be possible—one could obtain help and advice readily. It was difficult to do more than generalise in the course of a short address. But he had pointed out, and he emphasised it again, that mechanisation must not be regarded as something which could be poured out of a bottle and could be relied upon to produce a change for the better, magically, in any foundry. He recalled also his point that a jobbing foundry might with advantage consider whether the sand, which was handled in large quantities, was being handled in the best possible way.

More Skilled Labour Used

MR. G. C. PIERCE (Past Branch-President) recalled a conversation in which he had taken part some years ago, as to whether the mechanisation of foundries would result in the elimination of skilled work, and said that on that occasion Mr. Faulkner had expressed the opinion—which he might or might not have intended seriously—that eventually skilled workers would not be needed. Having had occasion from time to time to find out the numbers of skilled workers in the foundry industry, he could say that the mechanisation of foundries had brought in its train the need for a greater number of skilled workers or craftsmen than had ever been employed in the industry before. He asked whether Mr. France would care to express an opinion on that matter.

MR. FRANCE said that he subscribed generally to the statement that mechanisation had brought in its train a greater demand for skilled workpeople.

Vote of Thanks

MR. W. B. LAKE, J.P. (Vice-President of the Institute), proposing a hearty vote of thanks to Mr. France for his address, endorsed Mr. Burns' remark that it was well worth publishing and distributing throughout the industry, for Mr. France had viewed mechanisation from a common-sense standpoint. He had given ideas as to the cases in which its application would really pay, and how to ascertain whether or not it would pay, and he was to be congratulated on the lucidity with which he had expressed his views.

One could not help reflecting upon the opportunities afforded for education by the meetings of the Institute. There were lectures on how to make castings, which sands should be used, the best methods of handling the furnaces, and even the costs; and Mr. France had reached an even higher plane, for he was teaching his colleagues how to consider the economics of mechanisation.

MR. V. C. FAULKNER seconded, and thanked Mr. France, particularly for having given so thoughtful an address at short notice. The subject was made up of problems which afforded great scope to the "antis" and the "pros," but Mr. France had dealt with it so skilfully that he had avoided treading on anyone's toes.

The vote of thanks was carried with acclamation.

Special Sources of Information

The Association of Special Libraries and Information Bureaux held a luncheon at the Cafe Royal, London, on April 27, at which over 80 people were present. After saying that he hoped the luncheon would become an annual event, the President, Sir Harry Lindsay, Director of the Imperial Institute, spoke of the three stages of science, first scholasticism, dominated by the great scientists, then the the period of the authoritative text-books, now the era of the individual specialist. The results of modern scholarship were scattered in innumerable technical journals and in order to keep abreast, search must be made over a very wide field. The same was no less true of other spheres of knowledge. A.S.L.I.B. was therefore formed to act as a guide to specialist sources of information.

Foundry Costing*

By A. R. PARKES

Foundry costing is the scheme by which the actual cost of a casting to a company is computed by the management. This definition covers a multitude of varying practices according to the methods of control for departments, labour and materials within the foundry. All methods of finding the cost of a casting can, however, be subdivided into at least three component sub-costs, namely, (*a*) material cost, (*b*) labour cost, (*c*) overheads or fixed charges.

Material Cost

This is the cost of the material which forms the finished casting plus any other material which is used or wasted during its manufacture. It is quite clear, for example, that sand does not figure as part of the finished casting but that its cost must be taken into account when calculating the cost of any given casting. Material costing is usually calculated by totalling issues of raw material from departments (which may be regarded as stores), over a period, and dividing by a total production. Further details of the allocation of material costs will be given later.

Labour Cost

In considering the labour cost of a casting many varying methods of labour control and payment would have to be considered. However, for the moment, labour cost may be further subdivided into direct labour, such as a moulder's wages, and indirect labour, such as a truck unloader's wages. Two alternative terms for these subdivisions are productive and non-productive labour, though an exact dividing line between the two is hard to define.

Overheads

The third group, overheads or fixed charges, may generally be defined as costs which may or may not bear any definite relationship to the manufacture of the article in question, but which are part and parcel of the running and maintenance of any business. These charges include depreciation of machinery and its maintenance, office equipment and salaries, supervision, directors' fees, power, heating and lighting, etc., with always a host of sundry charges.

For the purposes of costing, "overheads" are often totalled up for a period, and assessed as a percentage of the total productive labour charges for that period, and then allocated to individual castings accordingly. This is a reasonable method of averaging overheads for general use, though it may in individual cases give a misleading or unbalanced cost. This is clearly shown by considering first a very simple, but heavy, casting made without cores and which may need no fettling, compared with a machine-moulded light casting, with cores and much fettling; in the first case the direct labour cost will be high, and consequently the overheads allocated may seem too high, as the casting should not bear core-shop or fettling-shop overheads, while the converse holds good for the other case cited.

Some foundry executives add sales charges, *i.e.*, salesman's commission, freight, packing and insurance to the "overheads," while others make these items an addition to the three main sub-costs previously mentioned.

"Gambling on the Overheads"

By this method, some firms sell larger quantities than arranged for at actual paper cost, with little or no profit allowance, on the assumption that profit will actually be accrued because, at very busy periods, the overheads represent a much smaller percentage of the direct labour charges. This works fairly well for busy periods, but so often the same selling prices are operative for smaller sales afterwards when the works is not so busy, and then losses are the result. Hence, the great need for periodic revision of overhead percentages.

Returned Scrap Problem

Foundry costing in relation to the valuation of shop returned scrap embraces the metal that is used in runners, scrap castings, etc., and its valuation has long been a bone of contention amongst foundry cost accountants. Here are two methods of reviewing the problem, both of which seem logical:—

(*a*) Where the melting shop and foundry are considered as separate departments for the method of departmental costs, the molten metal supplied by the melting shop to the foundry should be debited to the foundry at cost, say, £5 per ton. Then all scrap in the foundry during the week should be weighed (usually on the furnace platform when weighing out the charge) and "sold" back to the melting shop at scrap price, say £4 per ton (this value being the price at which outside supplies of similar material might be delivered at the works). This valuation at "scrap price" is the bone of contention, previously mentioned. One faction says that any cupola man would rather have shop scrap than bought scrap, so its value ought to be higher per ton than the bought scrap. Furthermore, another faction declares the metal in these runners and risers, etc., has cost much more than bought scrap—taking into account the pig-iron and cost of melting and so on—and so it ought to be valued at least at the average price of materials charged into the furnace. Both these factions have fallacious arguments. In the first place, metallurgically speaking, shop scrap is not of better quality than bought scrap of similar type. It is only because a cupola man knows what is in his own scrap that he prefers it. Secondly, the valuation of shop scrap at below cost is quite legitimate, since, in a manner of speaking, it is a waste product (like borings in a machine shop); it is unavoidable, and should be allowed for in the final cost or selling price of the casting. Thus the following deduction is permissible for obtaining the cost of the molten metal at the cupola spout:—

(1) Sold to foundry in one week, 100 tons molten iron at £5 per ton = £500.

(2) Received back by melting shop, 50 tons scrap at £4 per ton = £200.

∴ (3) Actual cost of metal in a good casting is: £300 for 50 tons, or £6 per ton.

(*b*) Where the various sub-sections of the foundry are grouped together, as far as material costs are concerned, the material cost of a finished casting can be ascertained by a complete list of issues of the various materials in a given period, and their cost divided by the weight of castings produced. The shop returned scrap is then not valued at all. A typical total raw material cost may then be drawn up on the following lines:—

		£	s.	d.
30 tons Derbyshire pig-iron at £5	=	150	0	0
30 tons bought scrap at £4	=	120	0	0
15 tons foundry coke at £2 10s.	=	37	10	0
7 tons Mansfield sand at £1	=	7	0	0
3 tons ganister at £2	=	6	0	0
3 tons limestone at 15s.	=	2	5	0
∴ 50 tons of good castings cost	=	£322	15	0
∴ Total raw material cost ...	=	£6 per ton.	9	1

The first method (*a*) of sub-departmental costing in the foundry has the advantage over the latter (*b*) in that individual costing of material for a casting is possible by the former method. For instance, by method (*a*) a casting made without cores need not, necessarily, bear indirect

(*Concluded on page* 392.)

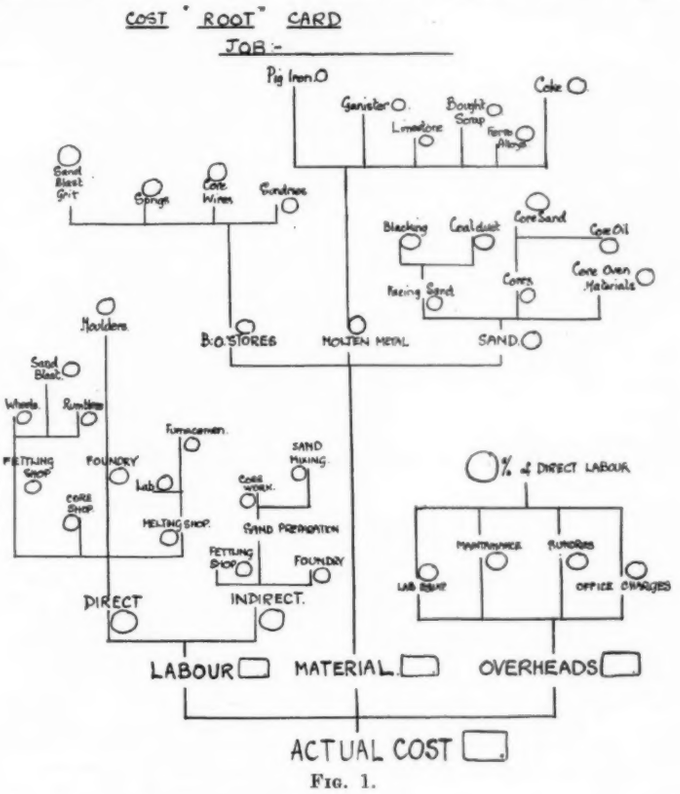


FIG. 1.

* Paper awarded second prize in a Short Paper Competition organised by the East Anglian Section of the Institute of British Foundrymen.

The New Factory Act—III

SPECIAL SAFETY REGULATIONS RELATING TO FETTLING

By F. J. TEBBUTT

There are special Regulations which lay down various requirements concerning the grinding or glazing of metals and the cleaning of castings. No racing, dry grinding or glazing must be carried on without the use of adequate appliances for the interception of dust as near as possible to the point of origin, and the appliances must ordinarily include: (1) a hood or other appliance; (2) a duct of adequate size, airtight, free from obstruction, and provided with proper means of access for inspection and cleaning, and where practicable with a connection at the end remote from the fan to enable any Factory Inspector to attach thereto any instrument necessary for ascertaining the pressure of air in the duct; (3) a fan or other means of producing a sufficient draft to extract the dust.

In the case of a particular factory, manufacturing process or operation, however, alternative appliances may be used, if it can be proved that they are as effective as the items mentioned. The provision of these meets the requirements concerning hacking and rodding, although, if a good supply of water is laid on at the upper surface of the grindstone, or the stone is wetted otherwise so that the dust is suppressed, the obligation is met.

Wet Grinding

Where wet grinding on a grindstone is carried on adequate exhaust and inlet ventilation (air renewed at least 12 times per hr.; continuous movement of the air to be in a direction from the grinder towards the grindstone; the fresh air inlets must not cause any worker to be exposed to a draft from them) must be provided, or alternatively, a supply of clean water conveyed by pipes and deposited on the grindstone must be provided and proper arrangements made for drainage of the water from the trough.

Glazing or other processes (except processes incidental to wet grinding) must not be carried on where wet grinding is done. Wet grinding must not be done in a room less than 10 ft. high, with the window area less than one-sixth of the floor area, and the windows must be glazed and the glass or other material maintained whole and kept clean. Actual grinding or glazing upon any grindstone, abrasive wheel or glazing appliance must not be done by more than one person at any time; assistance with heavy or bulky articles is, however, allowed. All parts of a room (and fixtures) in which racing or grinding upon a grindstone is done must be properly swept or cleaned once every three months; this does not apply to any part or fixtures if above 14 ft. from the floor.

No person employed at grinding, glazing or processes incidental thereto, must spit upon the floor, walls, etc., nor into or upon any appliance, plant or fixtures. Notice must be affixed showing the safe working peripheral speed of every class of grindstone and abrasive wheel in use, and the speed of the shafts or spindles and the diameter of the pulleys upon such shafts or spindles necessary to secure such safe working speed must also be specified.

The Fettling Shop

Where cleaning of castings (meaning the freeing from adherent sand, etc., the withdrawal or knocking-out of cores, core rods and lifters, the removal of ingates, risers or other projections or excrescences, and the general smoothing of the castings) is done, the following should be noted. The walls, ceilings or tops, and all other parts of the room, must be swept or otherwise cleaned at least once every three calendar months; floors must be similarly done every day, and it is necessary that the floor is maintained in a smooth and firm condition so as to permit proper sweeping or cleaning. It should be noted, however, that these requirements do not apply where cleaning of castings is done upon the floor at or near the place where the metal is poured, or to any room where the only castings dealt with are those already freed from sand or where rumbling is done in any room in which no other work is ordinarily performed if no person is wholly or mainly employed in the process.

In the case of cleaning or sweeping required where grinding or racing or the cleaning of castings (quarterly sweeping, that is) is done, an entry must be made in a register of dates. Particulars and the address of the person sweeping or cleaning, or the person in charge, if more than one, must be entered also. Any workman interested must be allowed to inspect such register on request.

Rumblers

Rumbling (which term includes rattling, tumbling or jigging, and means the freeing of castings from adherent sand by rotating them in a revolving vessel) must not be done unless the appliance is provided with efficient exhaust draft (or other arrangements are made which can be proved equally effective) so that any dust evolved is prevented from entering any occupied room. The obligation does not apply if rumbling is done where no other work is ordinarily performed, and if no person is not wholly or mainly employed in the process.

Sand-Blasting

Sand-blasting (meaning the cleaning or smoothing of castings by a jet of sand, metal shot, grit or other abrasive propelled by a blast of compressed air or steam) must only be done in an enclosed chamber or cabinet where no other work is performed and where means are provided to prevent dust escaping from the outside of the chamber or cabinet. If a person does (or assists at) sand-blasting (or works within 30 ft. of sand-blasting appliances) in the open air he must wear a protective helmet and gauntlets, and a person must not work in or remain in a sand-blasting chamber whilst the apparatus is in operation unless he is wearing a protective helmet, overalls and gauntlets. A protective helmet must carry a distinguishing mark of the person to whom it is issued and must be provided with a sufficient supply of pure air for breathing and ventilation, with suitable arrangements to permit the escape of the expired air. A protective helmet must not be worn by another person unless it has been thoroughly disinfected.

All ventilating plant must be examined and tested at least once every six months and any defect rectified, and a register must be kept containing particulars of such examination and test. It is the duty of every employee engaged in these operations to make proper use of the apparatus provided and to report forthwith any defect to a responsible person of the firm.

It might be useful to point out that where dust liable to explode on ignition is given off in any grinding, sieving or other process, or where there is present in any plant similar dust, or where any part of a plant may contain explosive or inflammable gas, there are special precautionary measures laid down in the Act, these provisions being new in factory legislation by this Act.

Foundry Costing

(*Concluded from page* 391.)

cost of core materials issued for the general run of castings, but with method (*b*) this is unavoidable.

Application of Costing

The first obvious use of a "cost" is to form a basis for a selling price of an article; a cost can, however, properly used, prove a valuable method of labour and supervision control. For this purpose a "root" system of cost recording can be used. This consists of a type of "family tree" inverted—hence the word "root." At the foot of a plain card is the actual cost of a casting as found by the costs department. Then, upwards, this cost is split up into allocations, *i.e.*, first labour, raw material and overheads, and then the ramifications of subdivisions. This chart is shown in Fig. 1.

These cards are printed out in blank form on a duplicator and the cost department fills in round figures the cost of the casting under consideration at various stages in its manufacture. For this purpose a circle by each allocation is provided on the blank. In due course this "root" card comes before the manager, who, with experience of similar jobs and other cards, is soon able to pick out at a glance points where the cost seems high. Then he holds an inquiry with the department concerned, and very often strange facts come to light, which may alter the whole process of making a casting. For instance, in one case a manager spotted that core materials for a casting were twice the metal cost of that casting—then an inquiry elicited the fact that the foundry method was badly designed and that, with a negligible pattern charge, the casting could be made without cores. All economies obtained are not as striking as the example, but nevertheless it is remarkable how quickly this "root" system shows up abnormal costs and departmental inefficiency.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Modern Methods of Sand Testing

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to an article on the above subject in the JOURNAL for April 21 by Mr. W. Y. Buchanan, a certain measure of plain speaking is called for in regard to the statement made upon my investigations on moulding sands at elevated temperatures, outlined at the top of the third column on page 331.

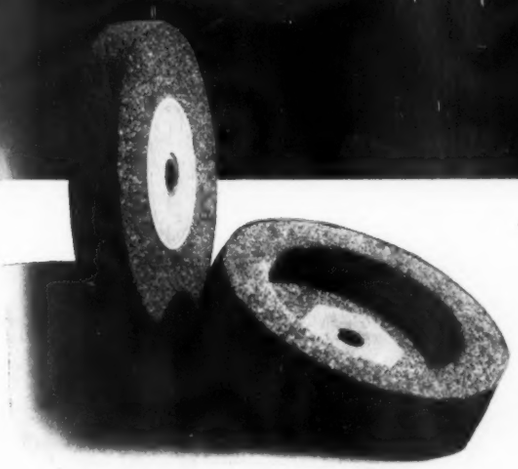
Mr. Buchanan mentions that my conclusions reached in regard to the effect of coal-dust, sawdust, etc., on expansion are erroneous, due to variations of the 2-in. A.F.A. test-piece due to flowability. Such is somewhat incorrect as, if Mr. Buchanan takes the trouble to refer carefully to the published Papers, it will be found that all my work on expansion was done on test-pieces 1¼ in. dia. by 2 in. long, rammed by double compression under similar methods to his own and not by A.F.A. methods. It is hoped that Mr. Buchanan's investigations are conducted with greater care than is accorded to his reading of other people's work. The matter is aggravated in a carelessly made statement of this kind when it is not backed up by any experimental evidence, and one cannot help suggesting that some published expression of regret is definitely indicated for such an obvious misleading statement.

Finally, may I be permitted to state that since completion of my investigations on the above subject the conclusions obtained have been applied to practice with complete confirmation, and the writer hopes to publish these results when opportunity permits.—Yours, etc.,

F. HUDSON.

"Glenfield," 11, Wyvern Road, Purley.
May 6, 1938.

REDUCING FETTLING COSTS



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For fast metal removal and economy.

For all fettling operations on castings, forgings, bars or billets.

For all kinds of metal.

For surface speeds up to 5,500 ft. per min using Vitrified wheels and up to 9,000 ft. per min. using Bakelite wheels.

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FROM
NORTON GRINDING WHEEL CO., LTD.,
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OR
ALFRED HERBERT LTD.,
COVENTRY

The Week's News in Brief

Trade Talk

CHAS. PORTWAY & SON, "Tortoise" Stove Works, Halstead, Essex, have been registered as a private limited company.

THE ANNUAL MEETING of the British Standards Institution, followed by a luncheon, will be held on June 14 at the Dorchester Hotel, London, W.1, at 11.15 a.m.

THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, have transferred their Newcastle office to larger premises at Ellison Buildings, Ellison Place, Newcastle-upon-Tyne.

THE KNOWSLEY CAST METAL COMPANY, LIMITED, brassfounders and finishers, have changed their address to Titan Works, Trafford Park Road, Trafford Park, Manchester, 17.

T. S. WILSON & COMPANY have transferred their works from Cuba Street, Millwall, London, E.14, to much larger premises in Manchester Road, Cubitt Town. The new works will be in operation as and from May 9.

BRITISH PIGIRONS, LIMITED, Abbey House, 2, Victoria Street, London, S.W.1, have been appointed by Barrow Hæmatite Steel Company, Limited, as Continental sales agents for the well-known Barrow, BHS, BX and BHR brands of West Coast hematite pig-iron.

THE SPATE of imports of iron and steel from the Continent to Tees-side has ceased. In January the imports reached 18,225 tons, in February they fell to 12,534 tons, in March to 6,052 tons, and last month to 1,226 tons. No pig-iron was imported in April, the shipments comprising 1,186 tons of semis and 40 tons of finished steel.

ROTARY FURNACES, LIMITED, of Brussels, have received an order for two Sesci furnaces of 3½ tons capacity for the new iron and steel foundry being erected at Wellington for the New Zealand Government Railways. One of these furnaces is intended to work on steel (for steel castings) and the other on the manufacture of synthetic cast iron for railway castings in general.

EXPORTS OF manganese ore from the U.S.S.R. last year totalled 1,000,805 metric tons, against 605,737 tons in 1936; iron-ore exports were 351,489 tons, against 25,894 tons. Exports of pig-iron were 236,046 tons and imports 245,061 tons. Other exports were: Bars, joists, etc., 53,216 tons; sheets and plates, 5,145 tons; pipes and tubes, 5,941 tons, and railway material, 21,372 tons. Imports included 33,260 tons of bars, joists, etc., 152,901 tons of plates and sheets, and 29,096 tons of pipes and tubes.

TWO PULLEY BLOCKS have been manufactured by Loveridge, Limited, Cardiff Docks, designed to lift bridge girders weighing about 100 tons. The blocks, which weigh approximately 2¼ tons, and take up about 14½ ft. of vertical space when coupled, were tested at Lloyds Proving House, Cardiff, the top block under a load of 170 tons, and the lower block, which is equipped with a Timken roller bearing on the swivel eye, under a load of 150 tons.

HAUTS FOURNEAUX DE SAULNES, JEAN RATY ET CIE., report a net profit of 17,070,195 fcs. for 1937, against 9,573,726 fcs. in 1936, and have declared dividends of 42.50 fcs., 36.85 fcs. and 38.42 fcs. per share on each of the three groups of shares. The Saulnes and Cassigny furnaces produced 170,852 tons of pig-iron, against 100,182 tons in 1936, when the Saulnes furnaces alone were in blast. Iron-ore output was 1,394,809 tons, against 1,234,166 tons in 1936 and 2,583,000 tons in 1929. Coke production advanced from 99,450 tons to 115,046 tons. The concern holds large interests in the Mines de Dourges, Aciéries de Longwy, and the Société des Hauts Fourneaux et Mines de Halanzy.

THE 37TH ANNUAL LUNCHEON of the British Acetylene Association was held at the May Fair Hotel, London, W.1, last Thursday. Mr. E. S. Parnwell, the new President, presided. Lord Dudley, M.C., who responded to the toast of "The Guests," which was proposed by Mr. C. S. Milne, emphasised the importance of acetylene in the iron and steel industries, and said he was glad that carbide was to be produced in this country. Referring to the art of fabrication by welding, he said that it had reached a pitch of perfection, but a vast field still lay ahead of it. Mr. Christopher J. Galpin (Director of Overseas Civil Aviation), also responding, spoke of the application of acetylene welding in aircraft production, and pointed out that in times of emergency it would be of inestimable value that the acetylene industry was already well organised. The value of such organisation was stressed also by another speaker, Sir William Letts, K.B.E., and the President, responding to the toast of the Association and its President, said that progress on a thoroughly sound basis was being made. One of the tasks confronting the Association was to organise a British delegation to participate in the thirteenth International Acetylene Congress at Berlin next year. Mr. L. J. Tibbenham, the retiring President, expressed disappointment that the textbook which the Association was preparing had not been published during his year of office; but it was nearly completed, and would undoubtedly become a standard work. The gathering was also addressed by Mr. F. S. Thorn, one of the earliest Presidents of the Association.

Personal

MR. W. J. MCLARDY has been re-elected assistant and financial secretary of the United Patternmakers' Association for a further term of three years.

MR. R. A. MONTGOMERY, formerly of Hydepark Locomotive Works, Glasgow, has been appointed works manager and chief metallurgist to the newly-merged concern of Andrews Toledo, Limited, and Darwins, Limited, of Sheffield.

MR. JOHN HAKER, late chief engineer to the Enfield Rolling Mills, Limited, of Brimsdown, has joined John A. Smeeton, Limited, iron and steel works and foundry engineers, of 17, Victoria Street, London, S.W.1, as a director and chief engineer.

DR. PAUL D. MERICA, a Vice-President of the International Nickel Company of Canada, Limited, has been awarded the John Fritz Medal, sponsored by four American engineering societies. Dr. Merica is a Vice-President of the American Institute of Mining and Metallurgical Engineers.

Wills

PEGLER, FRANK, managing director of Peglers, Limited, brassfounders, of Doncaster	£84,935
FEATHER, GEORGE, a former director of William Asquith, Limited, machine tool makers, Halifax	£1,428

Obituary

MR. HENRY BRIER, a director since 1907 of Seagers, Limited, engineers and founders, of Dartford, Kent, died on May 7 after a brief illness.

MR. STANLEY BROTHERHOOD, chairman of Peter Brotherhood, Limited, engineers and ironfounders, of Peterborough, died on Monday at the age of 62 years. He was a former High Sheriff of Northamptonshire.

BY THE DEATH last Thursday of Mr. W. J. Molineux, the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen has lost its newly-elected President. It was only on April 22, at the annual general meeting, that Mr. Molineux—who was unable to be present owing to illness—was appointed to the office. He had been a member of the Council for a number of years, and had also served as Vice-President. Aged 49, he leaves a widow and three daughters. Mr. Molineux had a varied experience. Starting with Samuel Platt, Limited, of Wednesbury, he was next associated with the Lilleshall Company, Limited. Later he became foundry manager for W. H. Dorman & Company, of Stafford. He had also held appointments with Clarke, Chapman & Company, and with Lake & Elliott, Limited, of Braintree. Returning to the Midlands about eight years ago Mr. Molineux started as a foundry representative, acting on behalf of Augusts, Limited, of Halifax, the Constructional Engineering Company, Limited, of Birmingham, and latterly of Vogel & Schemmann, of Hagen. He had taken an active interest for many years in the I.B.F., and while in the north identified himself with the Newcastle-upon-Tyne Branch, of which he became Senior Vice-President. At the funeral at Birmingham Crematorium on Tuesday, Mr. D. H. Wood represented the President and General Secretary of the Institute, and several members of the Council of the Birmingham Branch were also present.

Company Meeting

Ransomes & Rapier, Limited

The annual meeting of Ransomes & Rapier, Limited, was held on April 30 at Waterside Ironworks, Ipswich. MR. R. R. STOKES, M.P. (chairman and managing director), who presided, said that the value of orders booked during the year, inclusive of the sluice gates and operating machines for the Mohammed Aly Barrage, constituted a high record, being over 40 per cent. in excess of 1936, and the balance of orders on hand at the end of the year was some 50 per cent. above the corresponding figure last year. While the rate of order booking dropped during the last quarter of 1937, from the number of inquiries since received, both at home and from abroad, the prospects for the current year were bright. A very satisfactory feature of the year's trading had been the steady increase in export business, and no effort was being spared to increase it further. The policy of reserving a definite proportion of their output for export would be continued. The balance sheet showed that there had been a considerable increase in the value of fixed assets, accounted for partly by the extension to the main girder and fitting shop and partly by the purchase of machine tools. Owing to late deliveries, they did not receive the benefit which they anticipated from these tools in 1937, and, in fact, incurred considerable extra expense due to the amount of machining which had to be done by outside firms at very great cost; with the large amount of work on hand they should prove of inestimable advantage during the current year. As for future prospects, the works were occupied to capacity, and the directors saw no reason why there should not be a return to a higher rate of dividend at the end of the year if all went well.

Company Reports

Kayser, Ellison & Company, Limited. — Interim dividend of 5 per cent.

Mason & Burns, Limited.—Dividend of 15 per cent. for year to March 31.

Atlas Steel Foundry & Engineering Company, Limited.—Interim dividend of 2s. per share on the ordinary shares.

British Oxygen Company, Limited.—Final dividend of 10 per cent. on the ordinary stock, making 17 per cent. for 1937.

Sir Lindsay Parkinson & Company, Limited.—Dividend on the deferred ordinary shares for the period ended December 31, 1937, of 10.0346d. a share.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Dewrance & Company, Limited, 4, St. Bride Street, London, E.C.4.—Capital, £600,000. Manufacturers of boiler mountings, valves, plant, machinery, etc.

Joshua Hindle & Sons, Limited.—Capital, £2,000. Brassfounders, etc. Directors: C. Hindle, 5, Beech Avenue, Outwood Lane, Horsforth, Leeds; W. Hindle.

Thomas Platt & Sons (Widnes), Limited.—Capital, £10,000. Engineers, iron and brass founders, etc. Directors: T. Platt, Wilmere House, Bold, Widnes; J. R. Platt, and H. Platt.

Western Alloys, Limited.—Capital, £2,000. Directors: R. H. Wright, "Neuralia," Bleadon Hill, Weston-super-Mare; E. C. Slade, T. St. J. B. Parnall, R. H. Moore, and A. E. Symmonds.

Forthcoming Events

JUNE 21-24.

International Engineering Congress:—To be held at the the Empire Exhibition, Bellahouston Park, Glasgow.

Institute of British Foundrymen

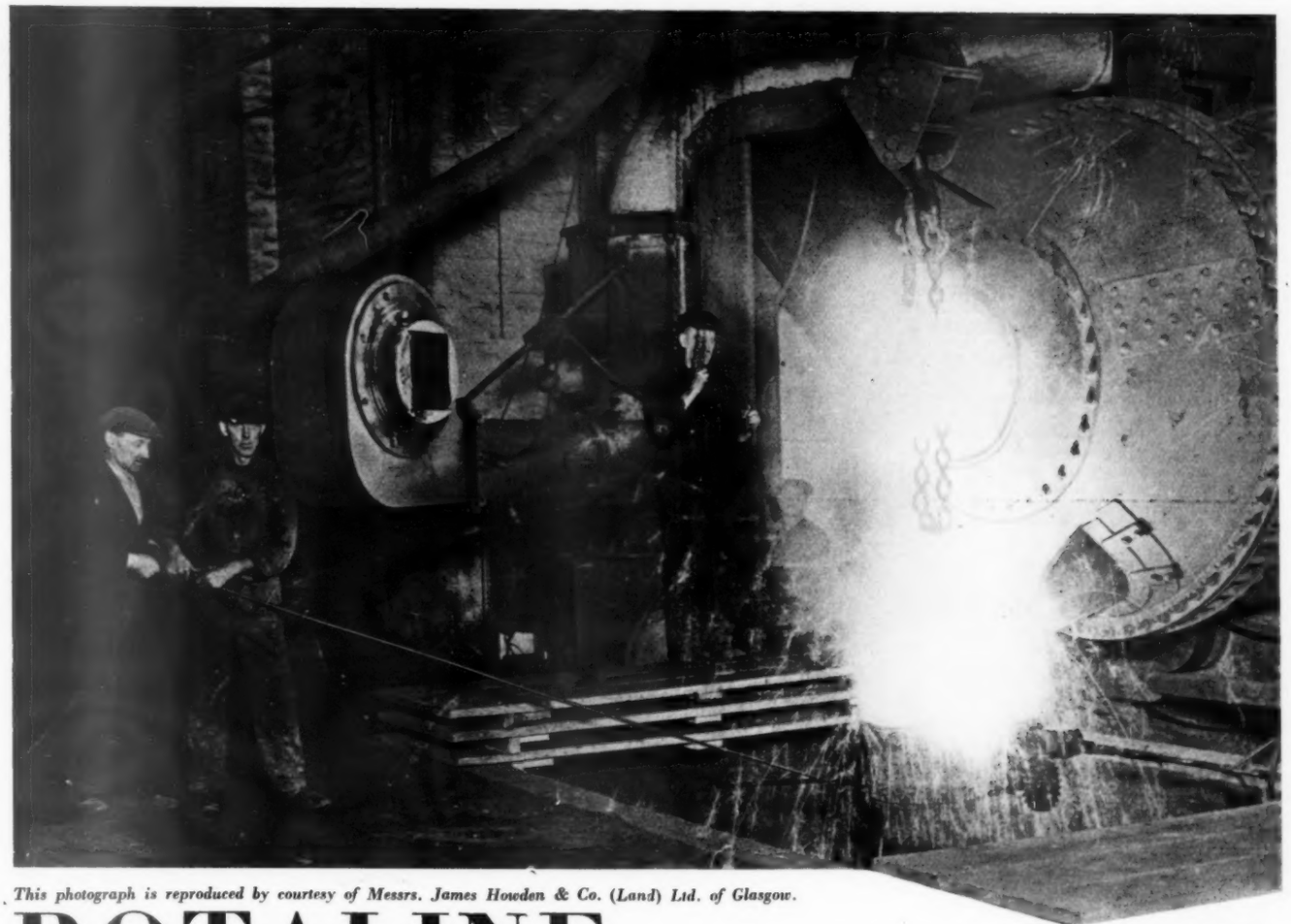
JUNE 14-17.

Thirty-fifth Annual Conference at Bradford.

The Institute of Vitreous Enamellers

JUNE 4-6.

Whitsun Conference at Glasgow.



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ROTALINE *ensures* ***longer life***

when used for the linings of Rotary Melting Furnaces

It presents a strong, durable lining, resistant to hard usage and severe slag attack. The low volume change of Rotaline obviates cracking and flaking of the lining.

Further information will gladly be given on request.

GENERAL REFRACTORIES Ltd.

Telephone: *Sheffield* 31113 (6 *lines*). **GENEFAX HOUSE, SHEFFIELD** *Telegrams:* "*Genefax, Sheffield.*"

LONDON OFFICE: Russell House. Adam St., Strand, W.C.2. Telephone: Temple Bar 3511. Telegrams: "Genefax, Rand-London." (Mr. A. C. Turner).

SCOTTISH OFFICE: 48, West Regent Street Glasgow, C.2. Telephone: Douglas 6108. Telegrams: (3 lines). "Genefax, Glasgow."

SWANSEA OFFICE: Metropole Chambers, Wind Street. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. F. Hood-Williams).

MANCHESTER OFFICE: 9, Albert Square. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE: Halifax Bldgs., Exchange Place. Telephone: Middlesbrough 3313. Telegrams: 'Genefax, Middlesbrough." (Mr. J. A. Williams).

BIRMINGHAM OFFICE: 5, Lower Temple Street Telephone: Midland 6376. Telegrams: "Genefax, Birmingham." (Mr. G. Griffiths).

Raw Material Markets

The quietness in the iron and steel trades is still apparent, and there is little indication of any change in the position. The absence of new business is resulting in further reductions in production. The continued lack of orders from abroad is accentuating the less satisfactory position of makers in this country.

Pig-Iron

MIDDLESBROUGH.—New business in foundry iron in this area is practically non-existent. Consumers are calling for a few small tonnages, but long-term contracts are not now being made. The reduced output on the North-East Coast is still too heavy, and makers' stocks continue to grow. One reason for the absence of new business, of course, is the fact that prices will come up for revision at the end of next month; also, stocks of foreign iron have by no means been completely absorbed. For delivery to Middlesbrough or Falkirk up to the end of June, No. 3 Cleveland G.M.B. iron is quoted at 109s., 111s. elsewhere on the North-East Coast, and 112s. on Clydeside, less 5s. per ton rebate.

All the blast furnaces at the Ayresome Ironworks of Gjers, Mills & Company, Limited, have been laid idle. Heavy stocks of iron, about 27,000 tons, are on hand at the works, and further production will be discontinued until these supplies have been disposed of. Three furnaces have been engaged on the production of hematite for Sheffield steelmakers. Thus, four furnaces producing hematite in this area have been closed down since the beginning of the year, and the number now in blast has been reduced to nine. Prices have been officially fixed for delivery up to the end of the year, but it is suggested in some quarters that reductions will have to be made before the expiration of that period. East Coast mixed numbers are quoted at 132s. 6d. on the North-East Coast, 138s. in Sheffield, and 143s. 6d. in the Midlands, all less 5s. per ton rebate.

LANCASHIRE.—There is little incentive for consumers to place further business at the present time, as they are well situated in the way of stocks, and there is the possibility of lower prices coming into force next month. The makers have not given any suggestion as to their intention with regard to prices for the second half of the year, but it appears to be generally thought that reductions will be made. Light-castings makers in this area continue to be rather badly off for work, while there has been some reduction in activity among the jobbing foundries. No improvement is noted with the textile machinists, but most of the machine-tool and heavy electrical engineers are well employed. For delivery to users in the Lancashire price zone, offers of Staffordshire and Derbyshire brands of No. 3 foundry iron are quoted on the basis of 114s., with Northants at 112s. 6d., and Derbyshire forge iron at from 111s. to 113s. per ton, according to the class of user. No expansion is noticeable in the demand for hematite. West Coast brands are quoted at 141s. and East Coast at 140s. 6d.

MIDLANDS.—The condition of the light-castings trade remains disappointing. There is generally a good flow of orders at this time of the year, but, so far, the usual activity has failed to materialise. Ironfounders' stocks in most cases are substantial. For delivery to Birmingham and Black Country stations, Northamptonshire No. 3 is quoted at £5 8s. 6d., with Derbyshire at £5 11s., both less 5s. rebate. Heavy engineers and motor-car makers are taking up larger tonnages of hematite and low-phosphoric irons. The price of the latter varies from about £5 15s. to £7 per ton, delivered the Midlands. The question of prices is holding up new business in hematite to some extent, as it is considered possible that reductions may be made in the current quotations, which, however, the makers say will remain in force up to the end of the year. As a result, generally speaking, only small tonnages are changing hands. East Coast hematite is quoted at £7 3s. 6d., with West Coast at £7 4s. 6d.

SCOTLAND.—Consumers are restricting their purchases to small tonnages. Export inquiries, also, are very few, and the market, generally, is dull. No. 1 foundry iron is quoted at 120s. 6d. and No. 3 at 118s., at furnaces. Short time is still general among light-castings founders, although a slight improvement is noticeable in this section. Local steelworks are well supplied with pig-iron, and little new business is going through. Hematite mixed numbers are quoted at 133s., Scottish basic at 107s. 6d., and English and Indian basic at 100s., all less 5s. rebate, f.o.t. steelworks here.

Coke

The price factor continues to dominate the foundry-coke market. Very little business is being transacted at present. Consumers complain that current quotations of 55s. 9d. for best Durham coke and 55s. to 62s. 6d. for Welsh, delivered to Birmingham and district, are too high, and they believe that producers will be compelled to make reductions later in the year.

Steel

The steel market continues to be rather inactive, although the principal consuming trades are taking large tonnages of material. The lull in new business, however, persists, and in most departments orders are being disposed of much more quickly than fresh contracts are being obtained. While this applies to the trade generally, the position at the heavy steel works is somewhat better than in the lighter branches, where the demand is affected by the substantial stocks which are weighing upon the market. Similar conditions rule in the semi-finished steel department. The demand for new finished products is slack, and, as a consequence, the stocks of semis at the consumers' works are being only slowly absorbed. In the finished steel market, the demand is steady, but is showing few signs of developing fresh strength. Most of the steelworks have sufficient orders in hand, however, to keep them well occupied for some months. Export business is quiet, but the recent interest shown by overseas buyers appears to have been maintained.

Scrap

Merchants are endeavouring to dispose of their heavy stocks of iron and steel scrap, but the demand is still very limited, and only meagre tonnages are being called for. Some grades are receiving more attention than others, but stocks of all qualities and descriptions are in excess of the demand.

Metals

Developments with regard to the tin buffer pool proposals have taken place during the past week; the result of the Malayan ballot is likely to be known within a short time.

Copper.—Following a meeting of copper producers in London recently, it was stated that producers of copper outside the United States had agreed to continue their co-operative arrangements. Despite this assurance, no favourable reflection was noticeable in market quotations. Quiet conditions continue to rule in the United States, where strikes at some of the automobile plants are restricting consumption. American domestic sales of copper in April totalled only about 23,000 short tons.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £38 18s. 9d. to £39; Friday, £38 10s. to £38 11s. 3d.; Monday, £38 11s. 3d. to £38 12s. 6d.; Tuesday, £39 3s. 9d. to £39 5s.; Wednesday, £38 17s. 6d. to £38 18s. 9d.

Three Months.—Thursday, £39 3s. 9d. to £39 5s.; Friday, £38 15s. to £38 16s. 3d.; Monday, £38 15s. to £38 16s. 3d.; Tuesday, £39 7s. 6d. to £39 8s. 9d.; Wednesday, £39 1s. 3d. to £39 2s. 6d.

Tin.—Further developments have taken place with regard to the buffer pool scheme for tin during the past week. Sir John Bagnall, chairman of the International Tin Committee, has announced proposals to the effect that, if the scheme is approved, two output quotas would be devised, one for export and one to produce stocks for the pool. The next meeting of the Committee has now been fixed for Thursday, June 2, in Paris. It is understood that the referendum of Malayan tin producers on the buffer pool scheme was begun on Tuesday last on a tonnage basis. The Government has issued the necessary papers, which are returnable within seven days. Consequently, the International Tin Committee expect to have the full details in their possession for their meeting in Paris.

The tone of the tin market in this country remains very uncertain, and prices have fluctuated rather widely. In the United States, also, the trend of the market is nervous. American tinplate mills are working around 45 per cent. of normal capacity, which is extraordinarily low for this time of the year.

Official quotations were as follow :—

Cash.—Thursday, £169 2s. 6d. to £169 7s. 6d.; Friday, £165 15s. to £166; Monday, £167 15s. to £168; Tuesday, £167 15s. to £168; Wednesday, £167 10s. to £167 15s.

Three Months.—Thursday, £169 10s. to £169 15s.; Friday, £166 5s. to £166 10s.; Monday, £168 5s. to £168 10s.; Tuesday, £168 10s. to £168 15s.; Wednesday, £168 to £168 5s.

Spelter.—A rather better demand has been forthcoming on industrial account, but the ontlook remains uncertain. The American Bureau of Metal Statistics reports that the world's output of slab zinc during March totalled 148,700 tons, against 140,500 tons in February. It is understood that tentative negotiations are in progress for a resumption of the International Zinc Cartel. Various attempts have been made to revive the Cartel in the past six months, and the market is not very hopeful at present that the new attempt will have any greater success.

Daily market prices :—

Ordinary.—Thursday, £13 2s. 6d.; Friday, £13 1s. 3d.; Monday, £12 17s. 6d.; Tuesday, £13; Wednesday, £13.

Lead.—There is little fresh buying being undertaken at the present time, and the market is dull. Some consumers took the advantage of lower prices to pick up small tonnages. World production of lead in March totalled 151,100 short tons, against 147,300 tons in the previous month, according to the American Bureau of Metal Statistics.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15; Friday, £14 15s.; Monday, £14 11s. 3d.; Tuesday, £14 13s. 9d.; Wednesday, £14 12s. 6d.

Scrap.—There is no improvement to report in business, and the demand is negligible. There have been certain price reductions this week.

Approximate selling prices for old metal :—New aluminium cuttings, £75; rolled, £60; cast, £30; foil, £88. Copper, £36 to £39; braziery, £33. Brass (clean), £22 to £24. Zinc, £7 10s. Lead, £12. Gunmetal, £38.

Nickel in Finland

According to a message from Helsinski, preparatory work for the exploitation of the nickel ore deposits in Kaulatunturi, in the extreme north of Finland, carried out on a large scale by the Mond Nickel Company, Limited, which holds the concession for the exploitation of these deposits, will soon be concluded, after which the extraction of the nickel ore will begin. It is expected that by 1940 production will be at the rate of 500 tons per day. After detailed investigations, the Kaulatunturi deposits are estimated to contain 3,000,000 to 4,000,000 tons of nickel ore.

IN STOCK

TILGHMAN RECONDITIONED SHOT OR SAND BLAST PLANTS

Rooms, Barrels, & Chambers.

WE SHOT AND SAND BLAST FOR ALL TRADES

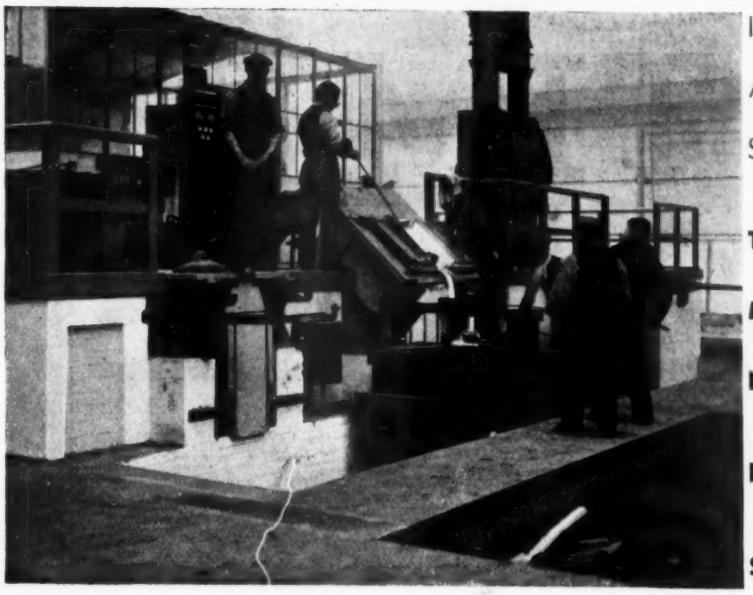
Established Fifty Years.

R. J. RICHARDSON & SONS, LTD.,
Commercial Street, Birmingham, 1.

Phone: MIDLAND 2281
Grams: "SANDBLAST, B'HAM"

EFCO HIGH FREQUENCY FURNACES

Complete range of furnaces including the largest yet made.



Ajax-Northrup High Frequency Furnaces and Efco Casting Bogie in a Sheffield Alloy Steel Foundry.

IDEAL FOR LARGE AND SMALL ALLOY STEEL CASTINGS:

TOOL STEELS

MAGNET STEELS

NON-MAGNETIC STEELS

HEAT-RESISTING STEELS

STAINLESS STEELS

ELECTRIC FURNACE CO. LTD

17 VICTORIA STREET
LONDON S.W.1

EFCO

Pioneers and Specialists in complete Electric Melting Equipments

Limited.

WARNER Special PIG IRONS

- Warner C.B.R. and Low Carbon Cylinder
  (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable
  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD
CARGO FLEET MIDDLESBROUGH

TIME MARCHES ON!

RANDUPSON

Congratulations to the Dry Sand Non-ferrous (yellow metal) Founders on their energy and vision—Randupson has proved its case and is now sweeping that field.

PROGRESS

Many Dry Sand Iron and Steel Founders are now investigating. The technique and our service have been proved in this country to be worthy of the Process. If you are prepared to simplify your operations and appreciate lower costs, ask us to prove our statement.

HINCKLEYS LIMITED
11, PARADE CHAMBERS - EAST PARADE
SHEFFIELD, 1.

RAW MATERIALS—PRICE LIST

(Wednesday, May 11, 1938)

COPPER

	£	s.	d.
Standard cash	38	17	6
Three months	39	1	3
Electrolytic	42	15	0
Tough	42	5	0
Best selected	42	15	0
Sheets	73	0	0
India	54	7	6
Wire bars	44	0	0
Ingot bars	44	0	0
H.C. Wire rods	47	10	0
Off. av. cash, Apr. ..	39	7	0 5/16
Do., 3 mths., Apr. ..	39	12	2 1/16
Do., Sttlmnt., Apr. ..	39	7	2 5/16
Do., Electro, Apr. ..	43	17	2 1/16
Do., B.S., Apr.	43	12	6
Do., Wire bars, Apr. ..	44	6	3 1/16
Solid drawn tubes			12¼d.
Brazed tubes			12½d.
Wire			8d.

BRASS

Solid drawn tubes	11d.
Brazed tubes	13d.
Rods, drawn	8¼d.
Rods, extd. or rlld.	6¼d.
Sheets to 10 w.g.	8½d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	6¼d.

TIN

	£	s.	d.
Standard cash	167	10	0
Three months	168	0	0
English	167	10	0
Bars	169	15	0
Straits	169	15	0
Eastern	169	5	0
Banca (nom.)			—
Off. av. cash, Apr. ..	168	15	5 10/16
Do., 3 mths., Apr. ..	169	7	7 1/16
Do., Sttlmt., Apr. ..	168	15	0

SPELTER

	£	s.	d.
Ordinary	13	0	0
Remelted	10	10	0
Hard	10	5	0
Electro, 99.9	16	17	6
English	14	5	0
India	13	0	0
Zinc dust	18	0	0
Zinc ashes	5	7	6
Off. aver., Apr.	13	16	5 3/16
Aver.. spot, Apr.	13	14	6 1/16

LEAD

	£	s.	d.
Soft foreign, ppt.	14	12	6
Empire (nom.)	15	11	3
English	16	15	0
Sheets, home	22	10	0
Do. export	18	15	0
Pipes, home	22	0	0
Do. export	19	7	6
Tea lead	30	10	0
Off. aver., Apr.	15	12	0 1/16
Aver.. spot, Apr.	15	11	6 1/16

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil ..	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.		£	s.	d.
Zinc sheets, English	27	15	0	to 28	5	0	
Do., V.M. ex-whse.	27	15	0	to 28	5	0	
Rods				19	10	0	

ANTIMONY

	£	s.	d.		£	s.	d.
English ..	75	0	0	to 78	0	0	
Chinese, ex-whse.				58	0	0	
Crude, c.i.f.				37	0	0	

QUICKSILVER

	£	s.	d.
Quicksilver	12	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.		£	s.	d.
Ferro-silicon—							
25%	11	10	0				
45/50%	12	0	0				
75%	17	0	0				
Ferro-vanadium—							
35/50%	14/- lb. Va.						
Ferro-molybdenum—							
70/75% carbon-free ..	4/9 lb. Mo.						
Ferro-titanium—							
20/25% carbon-free ..	9d. lb.						
Ferro-phosphorus, 20/25%	£21 to £22						
Ferro-tungsten—							
80/85%	4/8 lb.						
Tungsten metal powder—							
98/99%	4/9½ lb.						
Ferro-chrome—							
2/4% car.	34	15	0				
4/6% car.	24	5	0				
6/8% car.	24	0	0				
8/10% car.	24	0	0				
Ferro-chrome—							
Max. 2% car.	36	0	0				
Max. 1% car.	38	5	0				
Max. 0.5% car... ..	41	0	0				
70% carbon-free ..	10d. lb.						
Nickel—99.5/100%	£180 to £185						
"F" nickel shot ..	£165	0	0				
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.						
Metallic chromium—							
96/98%	2/5 lb.						
Ferro-manganese—							
76/80% loose	£18	15	0	to 19	5	0	
76/80% packed	£19	15	0	to 20	5	0	
76/80% export	£22	0	0				
Metallic manganese—							
94/96% carbon-free ..	1/3 lb.						

Per ton unless otherwise stated, basis 2-ton lots.

SCRAP

	£	s.	d.		£	s.	d.
South Wales (West)—							
Heavy steel, best	3	8	9	to 3	11	3	
Mixed iron and steel	3	6	9	to 3	9	3	
Heavy cast iron	3	8	9	to 3	11	3	
Good machinery			3	12	6		
Cleveland—							
Heavy steel, best	3	7	0	to 3	9	6	
Steel turnings	2	13	0	to 2	15	6	
Heavy cast iron			3	12	6		
Heavy machinery			4	0	0		
Midlands—							
Short heavy steel			3	12	6		
Light cast-iron scrap			3	2	6		
Heavy wrought iron ..	4	0	0	to 4	5	0	
Steel turnings	2	6	3	to 2	8	9	
Scotland—							
Heavy steel, best	3	5	0	to 3	7	6	
Ordinary cast iron	3	15	0	to 3	17	6	
Cast-iron borings	2	0	6	to 2	3	0	
Wrot-iron piling	4	5	0	to 4	7	6	
Heavy machinery	4	1	6	to 4	2	6	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	32	0	0
Brass	20	10	0
Lead (less usual draft) ..	13	0	0
Tea lead	10	0	0
Zinc	6	10	0
New aluminium cuttings ..	67	0	0
Braziery copper	29	0	0
Gunmetal	31	0	0
Hollow pewter	115	0	0
Shaped black pewter ..	78	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 3s. 0d.
Finished bars, 18% tungsten 3s. 10d.
Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
,, No. 3	109/-
,, No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas. ..	133/-
,, d/d Birm.	144/6
Malleable iron d/d Birm. ..	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
,, No. 3 fdry.	111/-
Northants forge	107/6
,, fdry. No. 3 ..	108/6
,, fdry. No. 1 ..	111/6
Derbyshire forge	110/-
,, fdry. No. 3 ..	111/-
,, fdry. No. 1 ..	114/-
Scotland—	
Foundry, No. 1, f.o.t. ..	120/6
,, No. 3, f.o.t. ..	118/-
Cleveland No. 3, Glasgow	112/-
,, ,, Falkirk ..	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
,, fdry. No. 3 ..	108/6
Lincs forge	107/6
,, fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3 ..	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3 ..	112/6
Cleveland fdry. No. 3 ..	114/-
Glengarnock, No. 3 ..	140/-
Clyde, No. 3	140/-
Monkland, No. 3	140/-
Eglinton, No. 3	140/-
Gartsherrie, No. 3 ..	140/-
Shotts, No. 3	140/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.		£	s.	d.
Bars (cr.) ..	13	5	0	to 13	15	0	
Nut and bolt iron	11	12	6	to 12	2	6	
Hoops				14	2	6	
Marked bars (Staffs) f.o.t.				15	15	0	
Gas strip				14	2	6	
Bolts and nuts, ¾ in. × 4 in.				17	10	0	and up
Steel—							
Plates, ship, etc.	11	8	0	to 11	10	6	
Boiler plts.	11	18	0	to 12	0	6	
Chequer plts.				13	0	6	
Angles				11	0	6	
Tees				12	0	6	
Joists				11	0	6	
Rounds and squares, 3 in. to 5½ in.				12	0	6	
Rounds under 3 in. to ¾ in. (untested)				12	4	0	
Flats—8 in. wide and over				11	5	6	
,, under 8 in. and over 5 in.				11	10	6	
Rails, heavy				10	2	6	
Fishplates				14	2	6	
Hoops (Staffs)				12	19	0	
Black sheets, 24g. (4-t. lots)				15	15	0	
Galv. cor. shts. (,,)				18	10	0	
Galv. flat shts. (,,)				19	0	0	
Galv. fencing wire, 8g. plain				20	5	0	
Billets, soft, 100-ton lots ..				7	17	6	
Sheet bars				7	15	0	
Tin bars				7	15	0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11d.
Wire	12½d.
Rods	12½d.
Tubes	18½d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising ..	8d. to 1/2
Rolled—	
To 9 in. wide ..	1/2 to 1/8
To 12 in. wide ..	1/2½ to 1/8½
To 15 in. wide ..	1/2½ to 1/8½
To 18 in. wide ..	1/3 to 1/9
To 21 in. wide ..	1/3½ to 1/9½
To 25 in. wide ..	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard ..	102.50
O.-h. rails, h'y, at mill ..	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	34/6
Durham foundry	39/6
,, furnace	32/6
Scottish foundry	42/-
,, furnace ..	35/6 to 37/6

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box		20/3 to 21/6
,,	28×20 ,,		40/6 to 43/-
,,	20×10 ,,	..	29/-
,,	18¾×14 ,,	..	21/-
C.W.	20×14 ,,		19/- to 20/3
,,	28×20 ,,		38/- to 40/6
,,	20×10 ,,	..	28/8
,,	18¾×14 ,,	..	20/3

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron ..	£11	0	0	to £12	0	0	
Bars-hammered, basis ..	£20	0	0	to £22	0	0	
Bars and nail-rods, rolled, basis ..	£19	0	0	to £20	0	0	
Blooms ..	£18	0	0	to £19	0	0	
Keg steel ..	£30	0	0	to £35	0	0	
Faggot steel	£19	0	0	to £24	0	0	
Bars and rods dead soft st'l	£14	0	0	to £16	0	0	

All per English ton, f.o.b. Gothenburg. [Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.		
May	5	..	38	18	9	inc.	6/3
,,	6	..	38	10	0	dec.	8/9
..	9	..	38	11	3	inc.	1/3
,,	10	..	39	3	9	,,	12/6
,,	11	..	38	17	6	dec.	6/3

Electrolytic Copper

			£	s.	d.		
May	5	..	43	0	0	No	change
,,	6	..	43	0	0	,,	,,
,,	9	..	43	0	0	,,	,,
,,	10	..	43	0	0	,,	,,
,,	11	..	42	15	0	dec.	5/-

Standard Tin (cash)

			£	s.	d.		
May	5	..	169	2	6	inc.	182/6
,,	6	..	165	15	0	dec.	67/6
,,	9	..	167	15	0	inc.	40/-
,,	10	..	167	15	0	No	change
,,	11	..	167	10	0	dec.	5/-

Tin (English ingots)

			£	s.	d.		
May	5	..	169	2	6	inc.	182/6
,,	6	..	165	15	0	dec.	67/6
,,	9	..	167	15	0	inc.	40/-
,,	10	..	167	15	0	No	change
,,	11	..	167	10	0	dec.	5/-

Spelter (ordinary)

			£	s.	d.		
May	5	..	13	2	6	inc.	5/-
,,	6	..	13	1	3	dec.	1/3
,,	9	..	12	17	6	,,	3/9
,,	10	..	13	0	0	inc.	2/6
,,	11	..	13	0	0	No	change

Spelter (Electro, 99.9 per cent.)

			£	s.	d.		
May	5	..	17	0	0	inc.	3/9
,,	6	..	16	18	9	dec.	1/3
,,	9	..	16	15	0	,,	3/9
,,	10	..	16	17	6	inc.	2/6
,,	11	..	16	17	6	No	change

Lead (soft foreign, prompt)

			£	s.	d.		
May	5	..	15	0	0	inc.	2/6
,,	6	..	14	15	0	dec.	5/-
,,	9	..	14	11	3	,,	3/9
,,	10	..	14	13	9	inc.	2/6
,,	11	..	14	12	6	dec.	1/3

Lead (English)

			£	s.	d.		
May	5	..	17	0	0	inc.	5/-
,,	6	..	16	15	0	dec.	5/-
,,	9	..	16	15	0	No	change
,,	10	..	16	15	0	,,	,,
,,	11	..	16	15	0	,,	,,

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 0	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 12 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 16 8½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 4 0	8 12 6	8 12 6	8 16 3	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1932	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1933	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1934	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1935	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1936	8 15 0	8 15 0	8 15 0	8 15 0	8 18 1½	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 2 6½
1937	9 10 6	9 10 6	9 10 6	9 10 6	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	11 8 0	10 15 6
1938	11 8 0	11 8 0	11 8 0	11 8 0	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

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REGISTERED TRADE MARK

FOR EVERY TYPE OF CASTING

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REFRACTORIES — COKE — SAND

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOUNDRY MANAGER (27) desires change. Fully qualified metallurgist, experienced in all types of bronzes, light alloys, office and works administration. Accustomed to handling men, and obtaining results.—Box 932, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Superintendent or Manager desires change. Modern methods, good organiser, vast experience. High-duty or repetition production; economy; efficiency. First-class refs.—Box 926, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PRACTICAL and Technical Foundry Manager desires position, home or abroad. Experience jobbing, repetition, high-duty and ordinary cast irons, and non-ferrous. Fully conversant with modern foundry practice. Could start up foundry, and guarantee results.—Box 920, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN STEEL MOULDER required for large steel foundry in India. Preference will be given to men not exceeding 35 years and single, who have held a similar position or that of leading steel moulder, and who have had wide experience in steel jobbing foundries making castings up to 5 tons in green, dry and loam. Five-year agreement, with provident fund, free medical attention and free passages. Good salary according to qualifications, and home leave on re-engagement. Apply, by letter, enclosing copies of testimonials, and stating age, and whether married or single, to: "LOAM," c/o ABBOTTS, Eastcheap, London, E.C.3.

FOREMAN with experience in machine moulding wanted for grey-iron foundry making small castings for the electrical industry. State age, full qualifications and experience, salary required, and when free to: PERSONNEL DEPT. (F.T.J.), THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.

MERCHANT HOUSE requires Representative, age 30-40, and able to drive, with sound knowledge of iron foundry trade in Black Country. Applicant should have some experience of selling pig-iron, coke and foundry raw materials. Sound salary to suitable man. Send full details in confidence to: Box 928, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEEL MELTER urgently required by large foundry in India, to take charge of open-hearth melting plant manufacturing steel castings. Applicants must have held the position of first-hand smelter and must be prepared to sail at short notice. Five years' agreement with excellent salary, provident fund, free passages and medical attention, and home leave on re-engagement. Apply by letter, with copies of testimonials, stating age, and whether married or single, to: "REGENERATOR," c/o WM. ABBOTT, LTD., 32, Eastcheap, London, E.C.3.

STOREKEEPER-TIMEKEEPER required immediately by malleable iron founders (Yorkshire) specialising in repetition castings. Write giving fullest particulars of past experience, age, references, and wages required.—Box 922, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SITUATIONS VACANT AND WANTED—*Contd.*

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY MANAGER with established reputation desires change. Long experience in full charge with well-known firms, including Diesel engine, steam turbine, electrical engineering and power transmission work. Excellent record in the production of high-class castings in alloy and grey irons. (323)

AGENCY

ACTIVE AGENT with first-class connection, constantly covering London and 50 miles radius, seeks additional line, preferably Small Repetition Grey Iron or Brass Castings. Results absolutely guaranteed. Only well-established firms able to cope with substantial quantities entertained.—Box 856, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

MOULDING MACHINES WANTED.—Pneumatic type. To produce castings from plaster oddsides, not plates. Please send details to: Box 918, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Compressed-air Paint-spraying Plant and regular supplies of best quality Ganister.—Box 930, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SANDBLAST PLANTS.

ROOMS size, 12 ft. by 12 ft., 12 ft. by 9 ft., and 6 ft. by 6 ft.
Barrels: 54 in. by 36 in.; 36 in. by 30 in.; 30 in. by 20 in., etc.
Cabinet: 6 ft. by 4 ft.; 4 ft. 6 in. sq. by 3 ft. 6 in. sq., and 30 in. dia.
Table: 9-ft. Guttman.
Air Compressors in stock to suit any of the above plants.
Sand Mills: 7 ft. 6 in., 7 ft., 6 ft., 5 ft. and 4 ft. dia. pans.
Cupolettes: 10 cwts., 15 cwts. and 20 cwts.
Cupolas: 2 and 3 tons.
Morgan Tilting Furnaces: 250 and 400 lbs.
Heavy D.E. Grinding Machine: wheels 24 in. by 4½ in.
Sand Rammers, Disintegrators and Mixers. Air Compressors, Blowers and Exhaust Fans, Moulding Machines, etc., etc.

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CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

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Three first-class second-hand LANCASHIRE BOILERS; 30' x 8' 6" dia.; 130 lbs. working pressure. Immediate delivery.
VERTICAL BOILER, by Riley Bros.; 14' x 6' 6"; 110 lbs. w.p.
COCHRAN BOILER; 8' x 3' 9"; 100 lbs. w.p.
WIRE ROPES; ⅞" dia.; 360' long.
Write for "Albion" Catalogue.
ALBION WORKS, SHEFFIELD.
'Grams: "Forward." 'Phone: 23001 (10 lines).

MACHINERY—*Continued*

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO., LTD., Station Works, Ecclesfield, Sheffield.

'Phone **98** Staines.

INGERSOLL RAND Steam-driven Compressor, 355 c.f.p.m., 100 lbs. w.p.
2½-ton Morris Overhead Hand Crane, 19 ft. 6 in. span.
Riveted Steel Air Receiver, 6 ft. 6 in. by 2 ft. 6 in., 100 lbs. w.p.
HARRY H. GARDAM & CO., LTD., STAINES.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

MISCELLANEOUS

PIG-IRON high silicon foundry grey wanted. 100 tons weekly. Send analysis and terms to: Box 924, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REDROCK Moulding Sand, suitable for heavy iron castings and light castings, ungrounded.
STAMP BROS.,
117, BRIGHT STREET,
SHEFFIELD.

PLUMBAGO TERRA FLAKE — BLACKLEAD CORE GUM
Constant Qualities. — Free Samples.
VAUGHAN, JONES & CO.,
8, UNION STREET, LIVERPOOL, 3.

MOULDING SAND
CHURCH QUARRIES, BIRCLE,
BEST QUALITY ROAD SAND.
FOR over 30 years we have supplied this sand to many of the leading Foundries.
It is coarse, permeable, and found to be equal in all respects to the Scottish Rock Sands.
Enquiries to Head Offices, Huntley Brook Works, Bury, Lancs. Tel.: 641.

'Phone: 237 SLOUGH

TABOR Portable Shockless Moulding Machine for 18" × 36" boxes Price £60

TABOR Portable Shockless Moulding Machine for 24" × 48" boxes Price £90

Pig Iron Breaker, as new, £45
Core Stoves, several, various sizes, CHEAP
Tilting furnaces for brass, 16 in stock
Air Compressors, all types in stock
Sand blast plants, various types in stock

ALEX. HAMMOND, *Foundry Machinery Merchant.*
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BUY FROM ME AND SAVE MONEY'